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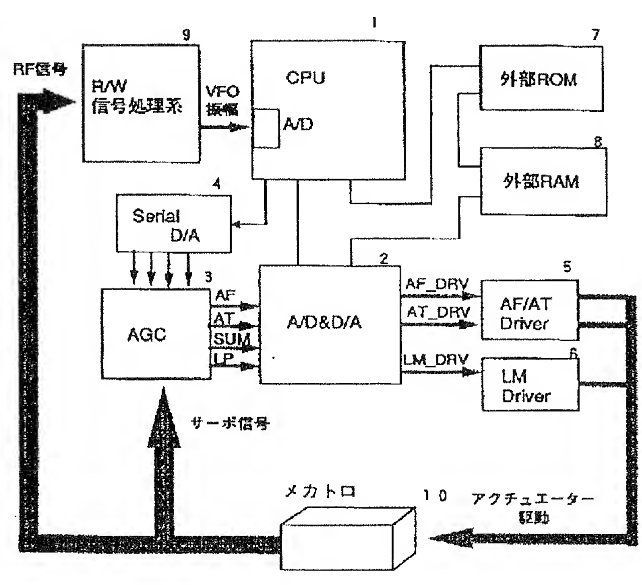
(54)【発明の名称】　光学式情報記録再生装置と情報記録再生装置

(57)【要約】
【目的】　ディジタルサーボにおけるサンプリング周波数の低さによる、あるいは量子化誤差によるＣＰＵ負担を軽減することを目的とする。
【構成】　光学的に識別可能な複数の情報トラックを有する記録媒体に光ビームを照射し情報の記録再生を行う光学式情報記録再生装置において、トラックを横切る方向に移動させる第１のアクチュエータと、第１のアクチュエータを移動させる第２のアクチュエータと、第１のアクチュエータの移動量を検出する移動量検出手段と、第２のアクチュエータを用いて移動するシーク手段と、シーク手段の動作中に前記移動量検出手段の出力により第１のアクチュエータを保持するシーク時保持手段と、シーク手段の動作中以外に第１のアクチュエータを保持するアクチュエータ保持手段とを有し、アクチュエータ保持手段の制御ループ帯域をシーク時保持手段の制御ループ帯域より狭くしたことを特徴とする。



【特許請求の範囲】
【請求項１】　光学的に識別可能な複数の情報トラックを有する記録媒体に光ビームを照射し情報の記録再生を行う光学式情報記録再生装置において、
前記光ビームのスポットの位置を前記情報トラックを横切る方向に移動させる第１のアクチュエータと、
前記第１のアクチュエータを搭載し、前記情報トラックを横切る方向に前記第１のアクチュエータを移動させる第２のアクチュエータと、
前記第１のアクチュエータの移動量を検出する移動量検出手段と、
前記光ビームを目標とする情報トラックへと前記第２のアクチュエータを用いて移動するシーク手段と、
前記シーク手段の動作中に前記移動量検出手段の出力により前記第１のアクチュエータを駆動し、前記第１のアクチュエータを保持するシーク時保持手段と、
前記シーク手段の動作中以外に前記移動量検出手段の出力により前記第１のアクチュエータを駆動し、前記第１のアクチュエータを保持するアクチュエータ保持手段とを有し、
前記アクチュエータ保持手段の制御ループ帯域を前記シーク時保持手段の制御ループ帯域より狭くしたことを特徴とする光学式情報記録再生装置。
【請求項２】　前記記録媒体からの反射光により、前期光ビームのスポット位置と前記情報トラックとの位置ずれ量を検出するトラック誤差検出手段と、
前記トラック誤差検出手段の出力の信号振幅を測定する振幅測定手段と、
前記振幅測定手段の動作中に前記移動量検出手段の出力により前記第１のアクチュエータを駆動し、前記第１のアクチュエータを保持する振幅測定時保持手段と、
前記振幅測定時保持手段の制御ループ帯域を前記シーク時保持手段の制御ループ帯域より狭くしたことを特徴とする特許請求の範囲第１項記載の光学式情報記録再生装置。
【請求項３】　光学的に識別可能な複数の情報トラックをもつ記録媒体に光ビームを照射し情報の記録再生を行う光学式情報記録再生装置において、
前記光ビームのスポットの位置を前記情報トラックを横切る方向に移動させるアクチュエータと、
前記記録媒体からの反射光により、前期光ビームのスポット位置と前記情報トラックとの位置ずれ量を検出するトラック誤差検出手段と、
前記トラック誤差検出手段の出力を所定サンプル周期にてサンプルするサンプリング手段と、
前記サンプリング手段の出力を前記所定サンプル周期にて演算を行い前記所定サンプル周期にて前記アクチュエータを駆動するサーボコントロール手段と、
前記サンプリング手段の出力を前記所定サンプル周期にて処理を行い、前記トラック誤差検出手段の出力を測定する測定手段とを有し、
前記光ビームのスポットの位置を前記情報トラックに整合させる場合には前記サーボコントロール手段を動作させ、前記トラック誤差検出手段の出力を測定する場合には前記測定手段を動作させることを特徴とする光学式情報記録再生装置。
【請求項４】　前記測定手段は前記トラック誤差検出手段の振幅を測定するためのメモリをもち、前記所定サンプル周期にて、前記サンプリング手段の出力値と前記メモリの値とを比較し、比較結果に応じて前記メモリの数値変化量を異ならせることを特徴とする請求項３に記載の光学式情報記録再生装置。
【請求項５】　前記数値変化量は前記サンプリング手段の出力値と前記メモリの値との差に比例した量であることを特徴とする請求項４に記載の光学式情報記録再生装置。
【請求項６】　光学的に識別可能な複数の情報トラックをもつ記録媒体に光ビームを照射し情報の記録再生を行う光学式情報記録再生装置において、
前記光ビームのスポットの位置を前記情報トラックを横切る方向に移動させる第１のアクチュエータと、
前記第１のアクチュエータを搭載し、前記情報トラックを横切る方向に前記第１のアクチュエータを移動させる第２のアクチュエータと、
前記第１のアクチュエータの移動量を検出する移動量検出手段と、
前記記録媒体からの反射光により、前期光ビームのスポット位置と前記情報トラックとの位置ずれ量を検出するトラック誤差検出手段と、
前記トラック誤差検出手段の出力を所定サンプル周期にてサンプルする第１のサンプリング手段と、
前記第１のサンプリング手段の出力を前記所定サンプル周期にて演算を行い前記所定サンプル周期にて前記第１及び第２のアクチュエータを駆動するサーボコントロール手段と、
前記所定サンプル周期以上の周期にて移動量検出手段の出力をサンプリングする第２のサンプリング手段と、
前記第２のサンプリング手段の出力により、前記第１のアクチュエータの移動量を測定する移動量測定手段とを有し前記第２のアクチュエータを停止させた状態で、前記サーボコントロール手段を動作させ、同時に前記移動量測定手段を動作させることを特徴とする光学式情報記録再生装置。
【請求項７】　前記記録媒体を回転させるモータと前記モータの回転位相を示す回転位相カウンタをもち、前記移動量測定手段は前記回転位相カウンタの値に同期して前記移動量を測定することを特徴とする請求項６に記載の光学式情報記録再生装置。
【発明の詳細な説明】
【０００１】

【産業上の利用分野】本発明はレーザービームを用いて情報記録媒体に情報の記録再生を行う光学式情報記録再生装置に関し、特に、ディスク状、あるいはカード状の記録媒体にトラック溝を設け、このトラックに沿って情報の記録再生を行う装置のレーザービームスポットの制御に関する。

【０００２】

【従来の技術および背景】光ディスク装置では、光源としての半導体レーザーが出射する光を、対物レンズによって直径１ミクロン程度に絞り込み、光ディスク上に照射する。

【０００３】この小さく絞り込まれた光スポットを光ディスクの情報記録媒体面上に合焦させるには、通常フォーカシングサーボと呼ばれるフィードバックループ制御が用いられる。

【０００４】また、媒体面上の情報トラックに光スポットの位置決めをするために、トラッキングサーボと呼ばれるフィードバックループ制御が用いられる。

【０００５】これらの制御ループは、通常以下の要素、

１．ディスクの反射光を受光する光センサ

２．光センサの出力を増幅する増幅器

３．増幅器の出力を所定レベルに抑える制御安定化補償器

４．制御安定化補償器により電力変換して駆動する対物レンズアクチュエータで構成される。

【０００６】上記光センサで受光する光量によって光スポットと光ディスク面とのフォーカス方向位置誤差を検出して、アクチュエータにより対物レンズを光ディスク面の垂直方向に移動し、光スポットをディスク面上に制御する。

【０００７】同様に光センサで受光する光量によってディスク上のトラックと光スポットのトラック方向位置誤差を検出して、アクチュエータにより対物レンズを光ディスク面に沿って移動し、光スポットをトラック上に制御する。

【０００８】

【発明が解決しようとする課題】しかしながら、現実の装置においては電気回路のもつオフセット、光学部品の取り付け誤差等によりフォーカス方向とトラック方向の位置誤差信号にオフセットが発生し、精度の高いサーボ系の構築の障害となっている。このため位置誤差信号のオフセットを装置の起動時等に自動的に調整する方法が考えられている。これらの方法の多くはサーボループ内に意図的に何種類かのオフセットを加えて、最良の信号が得られるようなオフセット補正を探求している。例えばフォーカスサーボループに２０段階程度のオフセットを順次印加し、トラッキング信号の振幅を測定し、最大のトラッキングエラー信号振幅を与えるオフセットを見いだし、これを調整オフセットとしてサーボループに加える。

【０００９】また近年、装置の小型化、低コスト化、高性能化を目指して、光ディスクのサーボ回路のディジタル化がさかんに行われている。ディジタルサーボでは、光センサから得られた位置誤差信号をＡ／Ｄ変換し、位置誤差量を数値化し、この数値をディジタル回路、マイクロプロセッサ、ＤＳＰ（デジタル・シグナル・プロセッサ）等で演算し、適正な駆動信号としてアクチュエータを駆動する構成をとる。ディジタルサーボでは必ず離散時間制御となるが、この場合、Ａ／Ｄ変換時間、ディジタル信号処理時間の関係から、サンプル間隔をむやみに精細高くすることはできない。

【００１０】例えば、光ディスク装置において最速の処理を必要とするトラッキングサーボにおいてでも、たかだか５０ＫＨｚ程度のサンプリング周波数となる。

【００１１】そこでディジタルサーボを行う場合、この低いサンプリング周波数のため、装置起動時の自動的な調整のための信号振幅の測定が困難になる。つまりトラッキングエラー信号を測定しようとする場合、ディスクの偏心によるトラック横断の最高周波数が５ＫＨｚ～１０ＫＨｚ程度となるため、５０ＫＨｚのサンプリング周波数では、トラック横断波形一周期につき５から１０サンプル点しか得ることができない。これではトラック横断信号の振幅値あるいはオフセットを正確に測ることができない。

【００１２】また、ディスク偏心によるトラック横断はディスク一回転で光スポットが偏心分の（正確には２倍）トラックを往復する。横断方向が反転する瞬間はトラッキングエラー信号が振幅値まで到達せず、中途半端な値でピークをもつ場合があり、やはりトラック横断信号の振幅、オフセットを正確に測ることができない。

【００１３】そのため、トラック横断信号の周波数を監視し、低い周波数および高い周波数での測定を禁止するような方策も考えられるが、測定精度を上げるためには測定許可周波数を広くすることができず、調整時間の増大を招いていた。またそのため調整精度もある程度妥協する必要があり制御性能を落としていた。

【００１４】また上述のトラック横断信号振幅測定時には対物レンズを固定、あるいは意識的に移動させる必要があるが、このためには対物レンズの位置を測定して、トラッキングアクチュエータにフィードバック制御を行う。一方光ディスク装置として必要な情報を再生あるいは記録するために、所望のトラックへ光ビームを移動させるシーク時には、この対物レンズがシーク移動による振動で揺すられないように固定する必要がある。しかし、シーク時の対物レンズの固定では、シーク移動による振動が大きいのでこの対物レンズ固定のフォードバックゲインを高くする必要がある。そのため、トラック横断信号振幅測定時の対物レンズ固定フィードバック制御ではデジタル制御で必ず残留する量子化誤差による駆動力がアクチュエータに大きく印加され対物レンズが微小

に振動する。そのため、高精度なトラック横断信号振幅測定が困難であった。

【００１５】またディスクの偏心量の測定にトラッキングサーボのサンプリング周波数と同じ５０ＫＨｚで行うと、ディスク１回転分の偏心量データを記憶したとき回転数が３６００ｒｐｍとして８３３個のメモリが必要となり、ＣＰＵ等のもつ貴重なメモリの大きな部分を占め、メモリ効率が非常に悪かった。

【００１６】

【課題を解決するための手段および作用】本発明は上記種々の欠点や問題点を解決するためになされたもので、光学的に識別可能な複数の情報トラックをもつ記録媒体に光ビームを照射し情報の記録再生を行う光学式情報記録再生装置において、光ビームのスポットの位置を情報トラックを横切る方向に移動させる第１のアクチュエータと、該第１のアクチュエータを搭載し、情報トラックを横切る方向に第１のアクチュエータを移動させる第２のアクチュエータと、第１のアクチュエータの移動量を検出する移動量検出手段と、光ビームを目標とする情報トラックへと第２のアクチュエータを用いて移動するシーク手段と、シーク手段の動作中に移動量検出手段の出力により第１のアクチュエータを駆動し、第１のアクチュエータを保持するシーク時保持手段を有し、シーク手段の動作中以外に移動量検出手段の出力により第１のアクチュエータを駆動し、第１のアクチュエータを保持するアクチュエータ保持手段とを有し、アクチュエータ保持手段の制御ループ帯域をシーク時保持手段の制御ループ帯域より狭くしたことを特徴とする。

【００１７】さらに、記録媒体からの反射光により、光ビームのスポット位置と情報トラックとの位置ずれ量を検出するトラック誤差検出手段と、トラック誤差検出手段の出力を所定サンプル周期にてサンプルするサンプリング手段とサンプリング手段の出力を所定サンプル周期にて演算を行い所定サンプル周期にてアクチュエータを駆動するサーボコントロール手段とサンプリング手段の出力を所定サンプル周期にて処理を行い、トラック誤差検出手段の出力を測定する測定手段を有し、光ビームのスポットの位置をトラックに整合させる場合にはサーボコントロール手段を動作させ、トラック誤差検出手段の出力を測定する場合には測定手段を動作させる。

【００１８】さらに、所定サンプル同期以上の周期にて移動量検出手段の出力をサンプリングする第２のサンプリング手段と、第２のサンプリング手段の出力により、第１のアクチュエータの移動量を測定する移動量測定手段をもち第２のアクチュエータを停止させた状態で、サーボコントロール手段を動作させ、同時に移動量測定手段を動作させることで、従来からの問題点が解決される。

【００１９】また、光学的に識別可能な複数の情報トラックを有する記録媒体に光ビームを照射し情報の記録再生を行う情報記録再生装置において、トラッキング誤差信号を検出する誤差信号検出手段と、光ビームを照射して対物レンズを情報トラックに追従するトラッキングサーボ手段とを有し、シーク時のトラッキング制御ループの帯域よりも再生時のトラッキング制御ループの帯域を狭くしたことを特徴とする。そうして、再生時には精密なサーボループで正確に追従し、シーク時には早期のジャンプ行為を達成できる。

【００２０】

【実施例】本発明による光学式情報記録再生装置のオフセットなどの自動調整における全体の概要を説明する。

【００２１】（１）ハードウエア構成

図２に本発明を実施した光磁気ディスク装置サーボ系のハードウエアのブロック図を示す。図において、１０はメカトロで、光ディスクを挿入されて光ディスクのトラックに従って記録再生するための光源、対物レンズ、信号処理用センサなどの光学系や、その信号を処理する電気系や、機械的に動作するアクチュエータ、スピンドルモータなどの機械系を内蔵し、９はメカトロ１０からの出力信号であるＲＦ信号から読み出し信号を復調したり、書き込みデータを変調したり、ＶＦＯ振幅信号を出力するなどのＲ／Ｗ信号処理系で、１はＣＰＵで、ハードウエアを含むシステム全体の制御を行ない、Ｒ／Ｗ信号処理系９からのＶＦＯ振幅信号を処理し、４はシリアルＤ／Ａで、３はメカトロ１０のフォーカス誤差信号やトラッキング誤差信号、シリアルＤ／Ａの出力などのサーボ信号の振幅を制御増幅するＡＧＣで、２はＡＧＣ３の出力をＡ／Ｄ変換したりＣＰＵ１による電圧データをＤ／Ａ変換してアナログ・デジタル相互の信号変換を行なうＡ／Ｄ＆Ｄ／Ａコンバーターで、５はＡ／Ｄ＆Ｄ／Ａコンバーター２からのオートフォーカス・トラッキングのドライブ信号を電力増幅してアクチュエータを駆動するＡＦ／ＡＴドライバーで、６はＡ／Ｄ＆Ｄ／Ａコンバーター２からのピックアップの位置を移動するリニアモータ用のドライブ信号を増幅するＬＭドライバーである。外部ＲＯＭ７と外部ＲＡＭ８はＣＰＵ１内のメモリでは不足の場合に使用されるプログラムや一時的なデータを記憶するメモリである。

【００２２】この実施例のサーボ処理は、ＣＰＵ１によるソフトウエアサーボである。サーボ系の自動調整もほとんどの部分ＣＰＵ１内のファームウエア処理で行っている。高速性が必要な図示せぬトラックカウント用コンパレータのスレッショルドの設定、およびＡＧＣ３のオフセット調整はＣＰＵ１内で処理できないので、シリアルＤ／Ａコンバーター４によりＣＰＵ１外の外部デバイスへ電圧を設定している。以下、各部の詳細を例示しつつ説明する。

【００２３】（２）ＣＰＵ１

ＲＩＳＣ（Reduced Instruction Set Computer）タイプのＣＰＵで、高速処理が可能でシステム全体を制御し、

ハードウエア乗算器を内蔵しているので１６＊１６＝３２ビットの乗算が１５０ｎｓで実行可能であり、８ビット、８ｃｈのＡ／Ｄコンバーターを内蔵している。

【００２４】（３）Ａ／Ｄ＆Ｄ／Ａコンバーター２

８ビットＡ／Ｄは時分割により８ｃｈ入力、８ｃｈスキャン動作時全チャンネル変換時間は１．７μＳである。８ビットＤ／Ａは４ｃｈ出力、３μｓ程度のセトリング時間を有している。

【００２５】（４）シリアルＤ／Ａ４

シリアル通信形１２ｃｈ、８ビットＤ／Ａコンバーターを有している。セトリング時間は３００μｓと低速である。

【００２６】（５）ＡＧＣ３

メカトロ１０からサーボセンサ出力８ｃｈを受け、フォーカス（ＡＦ）エラー信号／トラッキング（ＡＴ）エラー信号／総光量（ＳＵＭ）信号といった各サーボ信号を生成するとともに各サーボ信号の正規化（ＡＧＣ）動作を行う。また、メカトロ１０からレンズポジションセンサ出力を受け、レンズポジション（レンポジ）信号を生成し、レンズポジションを検出するレンポジＬＥＤにＡＰＣをかける。

【００２７】（６）ＡＦ／ＡＴドライバー５

ブリッジ型出力パワーオペアンプを２ｃｈ分有し、オートフォーカス・オートトラッキング用の電力増幅器で構成され、アクチュエータへの最大駆動電流は例えば０．７Ａである。

【００２８】（７）ＬＭドライバー６

レンズポジションを設定するリニアモータのドライバーで、ボイスコイルを駆動するドライバーであり、最大出力２Ａを有している。

【００２９】（８）外部ＲＯＭ７、外部ＲＡＭ８

ＣＰＵ１には内蔵のＲＯＭ、ＲＡＭがあるが、記憶容量が不足するため外部にもメモリを有している。主にシステムコントロール系の処理部用や、サーボのリアルタイム処理でない低速でも可能な処理で使用する。自動調整系であっても大きなメモリ領域を必要とし、高速性をあまり要求しない部分は外部ＲＡＭを用いている。

【００３０】（９）Ｒ／Ｗ信号処理９

ＲＦ信号の処理用部分で、メカトロ１０からの再生信号を復調して出力し、メカトロ１０の光ディスクに記録する信号データを高周波で変調してメカトロ内の電気系及び光学系に出力する。ＡＦオフセットの自動調整に必要なＶＦＯ振幅のホールド値を生成する信号処理部も構成されている。

【００３１】（１０）メカトロ１０

例えば３．５インチ光磁気ディスクを装着できるメカニックエレクトロニクスの略称メカトロである。通常の光磁気ディスクのヘッド、ディスク回転用のスピンドルモータ等で構成される。メカトロ１０内に通常の光磁気ディスク装置に搭載されているものと同様な分離光学タイプの光ヘッドがあり、可動部分であるキャリッジに搭載されている対物レンズは、フォーカス方向とトラッキング方向に移動可能なものとなっている。この対物レンズを移動させることによりフォーカスサーボ、トラッキングサーボが行われる。また、キャリッジと対物レンズのトラッキング方向の相対的な位置を検出するレンズポジション用センサが設けられており、トラッキング時にキャリッジを駆動するために用いられ、あるいはシーク中の対物レンズの位置固定のために用いられる。このセンサを対物レンズ位置センサと呼び、レンズポジションを検出することから「レンポジ」センサとも呼ぶ。このセンサの検出方法は、例えばフォトインタラプタといった光学的な投受光素子をキャリッジ部に固定し、対物レンズに係合した遮光板をフォトインタラプタの光路に置くことで実現できる。このキャリッジ部にはリニアモータが搭載され、第２のアクチュエータとして動作する。

【００３２】上記各部の構成により、メカトロ１０部分にある光ヘッドからの信号はＡＧＣ３により正規化されたサーボ信号となり、このサーボ信号をＡ／Ｄ＆Ｄ／Ａコンバーター２のＡ／Ｄコンバーターによりディジタル化する。

【００３３】フォーカスサーボループに関して説明すると、ＡＧＣ３から出力されるフォーカス誤差信号（図ではＡＦ）をＡ／Ｄ変換し、ディジタル値とする。そしてこのディジタル値に基づいてＣＰＵ１でサーボループ安定化のフィルタ演算を行い演算結果をＡ／Ｄ＆Ｄ／Ａコンバーター２のＤ／Ａコンバータに出力し、アナログ信号に変換（図ではＡＦ　ＤＲＶ）、ＡＦ／ＡＴドライバー５のＡＦドライバーアンプによりメカトロ１０内のフォーカシングアクチュエータを駆動する。

【００３４】同様にトラッキンググループも、ＡＧＣ３から出力されるトラッキング誤差信号（図ではＡＴ）を処理するもので、フォーカスサーボループと同様に構成され、ＡＴ　ＤＲＶとして出力された信号はＡＦ／ＡＴドライバー５のＡＴドライバーアンプによりメカトロ１０内のトラッキングアクチュエータを駆動する。これらの詳細は後述の説明で明らかにする。

【００３５】図１に本発明の実施例におけるサーボ系機能のブロック図を示す。

【００３６】サーボ系の多くの自動調整はＣＰＵ１内部のデジタル数値レベルで調整される。一部外部のシリアルＤ／Ａ４を用いる。

【００３７】（Ａ）フォーカスサーボ系

ＡＧＣ３からＡ／Ｄ＆Ｄ／Ａコンバーター２のＡ／Ｄコンバーター部分に入力され、ディジタル値に変換されたデータを、ＡＦ誤差Ａ／Ｄブロック２１のＡＦ誤差Ａ／Ｄ値として示す。ＡＦ誤差Ａ／Ｄブロック２１のＡＦ誤差Ａ／Ｄ値出力はＡＦオフセット２２のデータと加算器２３で加算され、オフセット調整されたＡＦ誤差データとなる。この加算器２３の出力であるモニタ点２４で示

すデータがＡＦ誤差信号の基本となり、フォーカスサーボの為の誤差信号、あるいはフォーカスはずれ検知等のモニタに用いられる。

【００３８】自動調整動作では、このＡＦオフセット２２のデータの値を実際に種々な値に設定して試用するために振ってみて、ＡＴ誤差信号の振幅あるいはＲＦ信号の振幅をモニタしてフォーカス最良点を見つける。

【００３９】モニタ点２４で示すデータは位相補償フィルタ２５で演算され、このデータはループゲイン調整のための変数ゲイン可変ブロック２６の可変制御信号と乗算器２７で乗算され、Ａ／Ｄ＆Ｄ／Ａコンバーター２のＡＦ駆動Ｄ／Ａコンバータ部２８に出力される。

【００４０】（Ｂ）トラッキングサーボ系

基本的にはフォーカスサーボ系と同じ構成である。ＡＧＣ３からＡ／Ｄ＆Ｄ／Ａコンバーター２のＡ／Ｄコンバーター部分に入力され、ディジタル値に変換されたデータをＡＴ誤差Ａ／Ｄブロック３１の出力として示す。ＡＴ誤差Ａ／Ｄブロック３１の出力はＡＴオフセットデータ３２と加算器３３で加算され、オフセット調整されたＡＴ誤差データとなる。ＡＴオフセット３２はＤＣ的なオフセットの他にレンズ位置によるオフセットの補正も行う。

【００４１】自動調整動作ではＡＴオフセットをゼロにしたときのモニタ点３４にあらわれるトラック横断時の信号振幅によりオフセットを測定する。その測定値に応じてＡＴオフセット３２のＡＴオフセット値を決定し、モニタ点３４で示すデータは位相補償フィルタ３５で演算され、このデータはループゲイン調整のための変数ゲイン可変ブロック３６の可変制御信号と乗算器３７で乗算され、Ａ／Ｄ＆Ｄ／Ａコンバーター２のＡＴ駆動Ｄ／Ａコンバータ部３８に出力される。その際、ＡＴ２値化スレッショルドＤ／Ａ３９のスレッショルド値の設定を行う。

【００４２】ＡＴアクチュエータはトラッキングサーボの他にジャンプ制御４０の駆動及びレンポジサーボ駆動を受ける必要があり、図ではそれをスイッチ４１で表現してある。そのスイッチ４１の出力は　ＡＴ駆動Ｄ／Ａ３８で電力駆動されて、ＡＴアクチュエータを駆動する。

【００４３】（Ｃ）レンポジサーボ系

フォーカスサーボ系と同様に、ＡＧＣ３のレンズポジションを示すＬＰ出力はＡ／Ｄ＆Ｄ／Ａコンバーター２のＡ／Ｄコンバーター部分にてデジタル化されてレンポジ誤差Ａ／Ｄ５１のデータとされ、初段でＬＰオフセット５２のＬＰオフセット値を加算器５３で加算され、レンポジモニタ点５４のデータとなる。次に位相補償フィルタ５５で補正演算を行い、さらにＬＰ駆動オフセット５６からのＬＰ駆動オフセット値を加算器５７で加算されて、調整されたレンポジデータとして各種機能モジュールに参照される。ここで、ゲイン精度を要求されないのでフォーカスサーボ系と異なり、ゲイン調整を行わない。

【００４４】ＡＴ誤差信号の振幅の測定の際、トラックを強制的に横断させるため、レンポジサーボの出力段に駆動オフセットデータとして低周波の駆動オフセット５６を加算器５７で加え、対物レンズを振動させている。

【００４５】（Ｄ）トレースサーボ系

レンポジ誤差Ａ／Ｄ５１のデータは、トレースオフセット６２によるトレースオフセット値を加算器６３で加算されて調整され、モニタ点６４とされ、次に位相補償フィルタ６５で補正演算され、リニアモータ用ＬＭ駆動Ｄ／Ａ６８にてアナログ値として出力され、各種機能モジュールに使用される。

【００４６】トレースオフセット６２は、ディスク回転時の偏心分をキャンセルする機能を有する。ディスク回転モータのスピンドルモータの回転に同期して１回転１００カウント程度づつカウントされるスピンドル回転同期カウンターをＣＰＵ１内に構成してあり、トレース時にスピンドル回転同期カウンターに同期して偏心分に相当するトレースオフセットデータを更新し、モニタ点６４では偏心成分の除去されたレンポジ信号となる。

【００４７】ＡＴサーボと同様に、位相補償フィルタ６５の出力とシーク制御ブロック６６との切り換えはスイッチ６７で実現している。そして、スイッチ６７の出力はＬＭ駆動Ｄ／Ａ６８に入力されて光学系の位置を移動するリニアモータを駆動する。

【００４８】（Ｅ）ＳＵＭ信号系

複数に分割されたサーボセンサの全ての出力を加算した信号をＳＵＭ信号と呼ぶ。ＳＵＭ信号をＡ／Ｄ＆Ｄ／Ａコンバーター２のＡ／Ｄ部でディジタルデータ化し、ＳＵＭ信号の２値化のスレッショルドデータを決定し、あるいはＳＵＭ信号によるＡＦはずれ検知スレッショルドデータの決定を行う。

【００４９】〔各アルゴリズムの説明〕以下、ＡＦオフセットにおける粗調整、微調整、及びはずれ検知レベルについて、またＡＴ＆ＳＵＭオフセットにおける粗調整、スライスレベル、及びはずれ検知レベルについて、さらに偏心量測定についてそれぞれ詳細に説明する。

【００５０】（１）ＡＦオフセット（粗調整、微調整、はずれ検知レベル）

図３に自動調整機能ブロック図（図１）のなかで、特にＡＦオフセット自動調整に必要な部分を抜き出して示す。

【００５１】フォーカスオフセット自動調整は大きく２つの自動調整に分かれる。一つはトラッキングエラー信号の振幅を指標にしたオフセット調整であり、もう一つはＩＤ部ＶＦＯ信号の振幅を指標にしたオフセット調整である。前者を「ＡＴ信号振幅によるＡＦオフセット自動調整」、後者を「ＶＦＯ振幅によるＡＦオフセット調整」と呼ぶ。

【００５２】ディスクを一定速度で回転させ、レーザー点灯、ＡＦ引き込み後に「ＡＴ信号振幅によるＡＦオフセット自動調整」を行う。その後、ＡＴ引き込み、トレース状態で「ＶＦＯ振幅によるＡＦオフセット調整」を行う。これら２つの自動調整は独立なモジュールであり、すべての自動調整を行うと最終的には「ＶＦＯ振幅によるＡＦオフセット調整」によるＡＦオフセットが設定される。

【００５３】これら２つのＡＦ自動調整を組み合わせることで、ＡＴ－ＭａｘとＶＦＯ－Ｍａｘの多少の差には対応可能なＡＦオフセット自動調整を構築できる。例えば、「ＡＴ信号振幅によるＡＦオフセット自動調整」により、実際に振るＡＦオフセットの量を制限する。あるいは「ＡＴ信号振幅によるＡＦオフセット自動調整」でのオフセット値と「ＶＦＯ振幅によるＡＦオフセット調整」でのオフセット値の中間レベルを最終設定ＡＦオフセットとする。

【００５４】次に、この「ＡＴ信号振幅によるＡＦオフセット自動調整」と「ＶＦＯ振幅によるＡＦオフセット調整」の詳細な説明をする。

【００５５】（ａ）「ＡＴ信号振幅によるＡＦオフセット自動調整」

まず、自動調整時のサーボ状態について説明する。ＡＦサーボまでかかった状態で、且つトラッキングサーボ調整用のＡＴアクチュエータはレンポジサーボで中央にホールドされた状態で、フォーカスサーボのオフセット自動調整を行う。

【００５６】ディスク信号面では、例えば３ビーム法によれば、トラッキング用のスポットは１つのトラックの片側ずつにずれた位置に配置され、両側の±１次光をトラッキング検出用のフォトセンサーで受け、センサー出力信号の差がＡＴ信号となる。また、プッシュプル法は２分割のビームによる反射波を４分割のフォトセンサーで受けてトラッキングエラー信号をＡＴ信号とする。ＡＴサーボの状態てはセンサー出力信号の差がゼロになるように対物レンズの位置を制御する。

【００５７】ＡＴ信号の振幅はＡＧＣ３の機能により影響をうける。ＡＧＣ３の正規化応答速度を高くすると、和信号の影響で、ＡＴ信号にひずみが生じる。このため、ＡＧＣ３の正規化信号すなわち和信号をピークホールドする必要がある。ＡＴ信号振幅の検出はこのピークホールド状態であることが必要である。

【００５８】レンポジサーボによりＡＴアクチュエータはほぼ可動範囲の中央に固定されるが、このとき、光スポットがトラックを横断することを保証するため、対物レンズを微少に振動させる。レンポジサーボループに正弦波の一定周期の駆動信号を与えて、対物レンズを振動させる。例えば周期約１００Ｈｚ、１０数μｍ程度の振動を発生させる。この駆動信号はＬＰ駆動オフセット５６として、図３のＬＰ誤差Ａ／Ｄ５１の出力にＬＰオフセット５２の信号を加算器５３で加算され、位相補償フィルタ５５で位相補償され、加算器５７でＬＰ駆動オフセット５６の出力信号を加えられるという構成のように、レンポジサーボのＡＴ駆動Ｄ／Ａ３８への出力直前に加え合わされている。これはレンポジサーボのデジタル信号による量子化誤差の問題で、レンポジサーボループの目標値として正弦波を加えることにより、ＡＴ駆動Ｄ／Ａ３８への出力直前で信号を加えた方が、なめらかな振動をさせることができるためである。

【００５９】また、なめらかな振動のためには、レンポジサーボの帯域を狭く設定する必要がある。一方、シーク中のレンポジサーボはシーク中の対物レンズの振動を極力抑える必要があるため、帯域を広く、つまりゲインを高くする必要がある。そのため、情報トラックのジャンプ制御による、シーク中のレンポジサーボの帯域を広くとり、その他の時でレンポジサーボの帯域を狭くする構成をとる。これはＣＰＵ１内の位相補償フィルタ５５のゲインとフィルタ特性を、シーク時と、それ以外の場合とで変更することで可能になる。このようにすることは、ＣＰＵ１を用いたＲＯＭに記憶されたプログラムによるソフトウエアサーボでは、何の弊害もなく簡単に実現可能である。

【００６０】シーク中のレンポジサーボの帯域を広くとり、その他の時でレンポジサーボの帯域を狭くすることにより、シーク中は対物レンズの振動を極力抑えることができ、トラックカウントにより検出する対物レンズの位置、移動速度の対物レンズの振動に起因する誤差をなくし、安定なシークを可能にする。

【００６１】また、ＡＦオフセット自動調整時にレンポジサーボ帯域を狭くすることで、対物レンズをスムーズに動かすことができ、偏心のないディスクでもトラック横断をさせることができ、かつなめらかに動かすことで、不要な振動による信号波形のひずみがなくなり、ＡＴ信号の振幅測定精度をあげることができる。

【００６２】さらには、シーク時以外のレンポジサーボ帯域を狭くすることで、不必要にアクチュエータに対して駆動力を与えない構成とし、消費電力を低減し、アクチュエータの発熱を抑えることができる。

【００６３】以下に、ＡＴ信号振幅によるＡＦオフセット自動調整の調整手順を説明する。ＡＦ引き込み時に測定してある、ＡＦ誤差信号の出力波形としてのＡＦ－Ｓ字のピーク値データをもとに、調整のためＡＦサーボループに印加するオフセットの振幅レンジを決める。例えばＳ字ピークの半分とする。このＳ字ピークの半分を、８等分した分解能でオフセットを変化させる。プラス・マイナス両方向とゼロポイントで１７ポイント測定する。

【００６４】まずオフセットゼロとして、ＡＴ信号の振幅を測定し、その振幅値とオフセット値を関連づけて記憶する。次に、上記の分解能で１ステップづつオフセッ

トをマイナス方向に変化させ、各ステップでのＡＴ信号振幅値と与えたオフセットを関連づけて記憶する。これを前記レンジの範囲内すなわち８ステップまで行う。

【００６５】また、このとき平行して、ＡＴ信号振幅の最大値判別を行い、各ステップ測定中に最大値の８０％を下回るＡＴ信号振幅が測定された場合、それ以上オフセットの絶対値を大きくしないシーケンスをとる。これは、極端に合焦状態が劣化してフォーカスがはずれることを防ぐためである。

【００６６】つぎに再び、ゼロまでオフセットを変化させ、マイナス方向同様に、今度はプラス方向の測定を行う。

【００６７】全てのポイントの測定が終了したら、ＡＴ信号振幅値の最大値を見つける。そして、最大値の８０％の振幅を与えるＡＦオフセットを算出する。この８０％を切るオフセット値は前後のオフセット値からの一次補間で求める。

【００６８】プラス方向及びマイナス方向各々の８０％低下オフセットの平均つまり中央を設定オフセットとする。

【００６９】最後に、その設定オフセットまで徐々にオフセットを変化させる。急激な変化はフォーカスはずれを引き起こすので良くない。また、フォーカスはずれ検知のスレッショルドレベルとしては、上記８０％をきるオフセット値を設定すればよい。

【００７０】次に、ＡＴ信号振幅測定方法について説明する。基本的にはピークホールドおよびボトムホールド動作で行なう。ピーク値あるいはボトム値の平均的な値を正しく測定できるように、またノイズに急峻に応答しないように、アタック／ホールド特性を設定してある。この際、ピークとボトムとの差の半分を振幅とする。そして、５０ＫＨｚサーボインタラプトタイミングで処理する。ＡＴ誤差Ａ／Ｄ３１の出力値を読みとり、ピークデータあるいはボトムデータとの差分の大小関係に応じて、アタック特性は差分の１／８を加算、ホールド特性は差分の１／１０２４を減算している。

【００７１】以上の処理と平行して、ピーク／ボトムデータを５０ＫＨｚサンプル毎に積算し平均化する。例えば測定時の印加フォーカスオフセット１ポイントにつき一回転分１６．６ｍｓの間のデータを平均する。

【００７２】つぎに、フローチャートを用いて説明する。図４には本発明によるＡＴ信号振幅測定のメインとなるフローチャートを、図５には同じくインタラプトモジュールのフローチャートを示す。

【００７３】例えば、トラック横断時のＡＴ信号振幅が±１００であったとする。ここでは＋１００側であるピーク値の検出方法について説明するが、－１００側の負のピーク（ボトム）の検出方法も、符号あるいは大小関係を考慮するだけで簡単に実現できるので説明は省略する。

【００７４】ステップ１（ｓ１）でピークホールド処理をスタートする。まず平均化のためのレジスタ、あるいは波形のピーク値のレジスタをイニシャライズする（ｓ１）。ピーク値のレジスタはＡＴ誤差信号のピークホールド処理の出力となるレジスタで、積算レジスタはピークホールド値を一定期間分平均化するための積算レジスタである。積算回数レジスタはピークホールド値を積算レジスタに積算した回数を示す。よって平均的なピーク値は「積算レジスタの値」／「積算回数レジスタの値」で算出できる。

【００７５】ステップｓ３において、開始フラグをセットすると、後で図５にて説明するインタラプト処理内のピークホールド処理が開始する。

【００７６】ステップｓ４ではピーク値レジスタが初期値から実際のピーク値に収束するまでの時間待ちをするため５ｍｓのタイマーをスタートさせる。

【００７７】ステップｓ５で５ｍｓ経過したことを判断し、次にステップｓ６で平均化開始フラグをセットする。これ以降、図５に示すインタラプト処理内では、ピークホールド処理が引き続き行われ、さらにピーク値の積算処理が開始される。

【００７８】ステップｓ７において平均化する時間を設定するタイマーを起動、ここではディスク１回転分の１６．６ｍｓの時間平均化することにする。ディスク１回転の間平均化することで、ディスクの周方向のばらつきも平均化することができる。

【００７９】ステップｓ８で１６．６ｍｓの経過を判断すると、ステップｓ９で開始フラグをリセットし、インタラプト処理内でのピークホールド、および積算処理を停止する。

【００８０】その後、ステップｓ１０で平均値の計算を行う。積算レジスタの値を積算回数レジスタの値で割ることで、ディスク１回転の間の平均ＡＴ信号振幅の平均のピーク値を算出することができる。

【００８１】次にインタラプト処理モジュールについて図５を用いて説明する。

【００８２】このインタラプト処理は、サーボ系の基本サンプル周波数である５０ＫＨｚで起動される。インタラプト処理内でこのモジュールが起動すると、まず、ステップｓ２２において開始フラグがたっているか否かチェックする。図４のメインフローチャートで開始フラグｓ３がセットされるまではステップｓ２３のリターンへ行き、モジュールが終了する。

【００８３】開始フラグがセットされると、ステップｓ２４へすすみピークホールド処理が行われる。ステップｓ２４でまずＡＴ誤差信号の入力されているＡＴ誤差Ａ／Ｄ３１のデータを読み込み、ステップｓ２５においてＡＴ誤差Ａ／Ｄ３１の値とピーク値レジスタのピーク値と比較する。読み込まれたＡＴ誤差Ａ／Ｄ３１のＡ／Ｄ値のほうがピーク値よりも大きければ、ステップｓ２６

へ進み、ピーク値レジスタのピーク値データを増やす、このとき実際のＡ／Ｄ値をピーク値とするのではなく、Ａ／Ｄ値と前回までのピーク値との差１／８だけピーク値データを増加させる。即ち、ピーク値として
ピーク値＝ピーク値＋｛（Ａ／Ｄ値－ピーク値）／８｝
の値をピーク値レジスタに設定する。これにより、ディスクの傷、あるいはノイズによるピークホールドの誤動作を防ぐことができる。

【００８４】逆に、Ａ／Ｄ値がピーク値よりも小さいときは、ホールド操作を行う。この場合、
ピーク値＝ピーク値＋｛（Ａ／Ｄ値－ピーク値）／１０２４｝
の値をピーク値レジスタに設定する。即ち、このときもピーク値データを保持するだけでなく、Ａ／Ｄ値と前回までのピーク値との差を１／１０２４してピーク値をゆっくりと減らすことでディスクの傷、あるいはノイズによるピークホールドの誤動作を防ぐことができる。

【００８５】ピーク値の操作が終わると、平均化開始フラグｓ６をチェックし、セットしていなければ、ステップｓ２９でモジュールを終了する。このルートを通るときはピーク値データが実際のピーク値へ収束するのを待っている５ｍｓのタイマ期間中である。

【００８６】平均化開始フラグｓ６がたっていれば、ステップｓ３０へ行き、積算レジスタにピーク値レジスタの値を積算すると共に、積算回数レジスタを＋１して積算回数を数える。そしてステップｓ３１でインタラプトを終了する。

【００８７】図４のメインフローチャートの１６．６ｍｓのタイマーがタイムアップすると開始フラグがリセットされる（ｓ９）ので、ピークホールド処理も積算処理も行われない。

【００８８】このようにして、５０ＫＨｚという離散的なサンプル点のデータのみでトラック横断時のＡＴ誤差信号が５ＫＨｚから１０ＫＨｚとサンプル周波数５０ＫＨｚに近いにも関わらず、正確なピーク値、ボトム値が割り出され、結局、ＡＴ誤差信号の振幅値ならびにオフセット値を測定することが可能になる。また、ピーク値の操作をデータ差の１／８あるいは１／１０２４としたことで、ノイズに強くかつ収束時間も適切に設定することができる。このようにノイズに強くしたことで、ＡＴ誤差信号に比較して非常にノイズの多いＳＵＭ信号であっても、トラック横断時の振幅を正確に測定することができる。つまり同様のアルゴリズムを、複数に分割されたサーボセンサの全ての出力を加算した信号であるＳＵＭ信号の振幅およびオフセットに用いても良好な測定結果を得ることができる。

【００８９】（ｂ）「ＶＦＯ振幅によるＡＦオフセット調整」
まず、自動調整時のサーボ状態について説明する。ＡＦサーボ、ＡＴサーボ、及びトレースサーボまでかかった状態で行う。

【００９０】ディスクのトラックの各セクタ中ビット同期信号とセクタアドレスなどを記録しているＩＤ部のＶＦＯ信号の振幅をホールドする必要があり、このＶＦＯタイミングを得るためにＩＤ再生系が正常に動作し、アドレスを再生可能な状態が必要である。

【００９１】つぎに、調整手順について説明する。上述の（ａ）「ＡＴ信号振幅によるＡＦオフセット自動調整」の場合と同様に、ＡＦ引き込み時に測定してあるＡＦ－Ｓ字のピーク値データをもとに、調整のためＡＦサーボループに印加するオフセットのレンジを決める。例えばＳ字ピークの半分とする。

【００９２】このピークの半分を８等分した分解能でオフセットを変化させる。プラスマイナス両方向とゼロポイントで１７ポイント測定する。

【００９３】まずオフセットゼロとしてＶＦＯ信号振幅を測定し、振幅値とオフセット値を関連づけて記憶する。次に、上記の分解能１ステップづつオフセットをマイナス方向に変化させ、各ステップでのＶＦＯ信号振幅値と与えたオフセットを関連づけて記憶する。これを前記レンジの範囲内すなわち８ステップまで行う。

【００９４】また、このとき平行して、ＶＦＯ信号振幅の最大値判別を行い、各ステップ測定中に最大値の８０％を下回るＶＦＯ信号振幅が測定された場合、それ以上オフセットの絶対値を大きくしないシーケンスをとっている。これは、極端に合焦状態が劣化してフォーカスがはずれることを防ぐためである。

【００９５】つぎに再び、ゼロまでオフセットを変化させ、マイナス方向同様に今度はプラス方向の測定を行う。

【００９６】全てのポイントの測定が終了したら、ＶＦＯ信号振幅値の最大値を見つける。そして、最大値の８０％の振幅を与えるＡＦオフセットを算出する。この８０％を切るオフセット値は前後のオフセット値からの一次補間で求める。

【００９７】プラス方向及びマイナス方向の各々の８０％低下オフセットの平均つまり中央を設定オフセットとする。最後にその設定オフセットまで徐々にオフセットを変化させる。ここで、急激な変化はフォーカスはずれを引き起こすので良くない。また、フォーカスはずれ検知スレッショルドレベルとしては、上記８０％をきるオフセット値を設定すればよい。

【００９８】つぎに、ＶＦＯ信号振幅測定方法について説明する。５０ＫＨｚサーボインタラプトタイミングの１／８でこのＶＦＯ信号振幅測定を処理する。メカトロ１０からのＲＦ信号によって、Ｒ／Ｗ信号処理系９にて検出されたＶＦＯ振幅データはＣＰＵ１に入力され、ＣＰＵ１のＡ／Ｄコンバータでデジタル化されてＶＦＯ振幅データを読みとり、５０ＫＨｚの１／８サンプル毎に積算し平均化する。例えば、各ＡＦオフセットポイント

につき１０ｍｓの間のデータを平均する。
【００９９】このようにして、ＡＦオフセットの値を設定するために、その粗調整、微調整及びはずれ検知レベルについて説明した。こうして、例えば「ＡＴ信号振幅によるＡＦオフセット自動調整」でのオフセット値と「ＶＦＯ振幅によるＡＦオフセット調整」でのオフセット値の中間レベルを最終設定ＡＦオフセットとする。そして、このオフセット値をメモリに記憶すると共に、図１のＡＦオフセット２２の出力レベルとして加算器２３に加えられる。
【０１００】（２）ＡＴ＆ＳＵＭオフセット（粗調整、スライスレベル、はずれ検知レベル）
以下、ＡＴ＆ＳＵＭオフセットにおける粗調整、スライスレベル、及びはずれ検知レベルについて、それぞれ詳細に説明する。自動調整機能のなかで、特にＡＴオフセット＆ＳＵＭオフセットの自動調整に必要な部分を抜き出して、そのブロック構成を図６に示す。
【０１０１】ディスクを一定速度で回転させ、光源としてのレーザー点灯、ＡＦ引き込み、ＡＴ信号振幅による上記（１）ＡＦオフセットによるＡＦオフセット自動調整後に、「ＡＴ＆ＳＵＭオフセット自動調整」を行う。
【０１０２】（ａ）「ＡＴ＆ＳＵＭオフセット自動調整」
まず、自動調整時のサーボ状態について説明する。ＡＦサーボまでかかった状態で、ＡＴアクチュエータはレンポジサーボで中央にホールドされた状態でＡＴ＆ＳＵＭオフセット自動調整を行う。ＡＴ信号振幅はＡＧＣ機能により影響をうける。ＡＧＣ３の正規化応答速度を高くすると、和信号の影響で、ＡＴ信号にひずみが生じる。このため、ＡＧＣ３の正規化信号すなわち和信号をピークホールドする必要がある。従って、ＡＴ誤差Ａ／Ｄ３１ではこのピークホールド状態であることが必要である。
【０１０３】レンポジサーボによりＡＴアクチュエータはほぼ可動範囲の中央に固定されるが、このとき、光スポットがトラックを横断することを補償するため、対物レンズを微少に振動させる。レンポジサーボループに正弦波の一定周期の駆動信号をＬＰ駆動オフセット５６に与え、対物レンズを振動させる。例えば周期約１００Ｈｚ、１０数μｍ程度の振動を発生させる。
【０１０４】この駆動信号は図６の構成のようにレンポジサーボのＤ／Ａ出力直前に加え合わされている。これは、Ａ／Ｄのデジタル化による量子化誤差の問題で、レンポジサーボループの目標値として正弦波を加えるより、Ｄ／Ａ出力直前で信号を加えた方がなめらかな振動をさせることができるためである。また、なめらかな振動のためにはレンポジサーボの帯域を狭く設定する必要がある。
【０１０５】次に、調整手順について説明する。ＡＴ誤差Ａ／Ｄ３１のデータからトラック横断時のＡＴ誤差信号のピークとボトムを測定する。ピーク値とボトム値の平均をＡＴオフセットとし、これをＣＰＵ１内でＡＴ誤差Ａ／Ｄ３１の出力に加算器３３で加算（ファーム上では減算）する。
【０１０６】また、ＡＧＣ－ＩＣ内にあるＡＴ信号２値化コンパレーターのスレッショルドレベルを設定するため、測定したＡＴオフセット値をハードウエアに対応した規定割合で変換してシリアルＤ／Ａ４にセットする。
【０１０７】同様にＳＵＭ－Ａ／Ｄのデータからトラック横断時のＳＵＭ信号のピーク値とボトム値を測定する。ピーク値とボトム値の平均をＳＵＭオフセットとし、これをＳＵＭ信号に２値化スレッショルドレベルとして各モジュールで用いられる。ＳＵＭ信号の２値化は外部のコンパレーターを用いないので、Ｄ／Ａに設定する必要は無い。また、ボトム値とゼロレベルとの平均、つまり中央値をＳＵＭ信号によるＡＦはずれ検知のスレッショルドレベルとする。
【０１０８】つぎに、ＡＴ＆ＳＵＭ信号オフセット測定方法について説明する。ＡＴ信号、及びＳＵＭ信号ともに、基本的測定方法は同じであり、以下にＡＴ信号の場合を中心に記述する。
【０１０９】基本的には、ピークホールドおよびボトムホールドによって動作する。上述のような平均化効果と、ノイズに急峻に応答しないように、アタック／ホールド特性を設定してある。そして、ピーク値とボトム値の平均値をオフセットとする。またピーク値とボトム値との差の半分を振幅とする。これを、５０ＫＨｚサーボインタラプトタイミングで処理する。
【０１１０】ＡＴ誤差Ａ／Ｄ３１の出力値を読みとり、ピークデータあるいはボトムデータとの差分の大小関係に応じて、アタック特性は差分の１／８を加算、ホールド特性は差分の１／１０２４を減算している。
【０１１１】以上の処理と平行して、ピーク／ボトムデータを５０ＫＨｚサンプル毎に積算し平均化する。例えば、現行バージョンでは１ポイントにつき一回転分１６．６ｍｓの間のデータを平均している。ＳＵＭ信号の場合は、読みとるＡＴ誤差Ａ／Ｄ３１の出力値をＳＵＭ－Ａ／Ｄ７１に置き換える。
【０１１２】ＡＴ＆ＳＵＭ信号オフセット測定方法は図４と図５で説明したＡＴ信号振幅測定のアルゴリズムと同様なので、詳細な説明は省略する。
【０１１３】（３）偏心量測定
自動調整機能のなかで、特に偏心量測定に必要な部分を、図７に抜き出して示す。まず、ディスクを一定速度で回転させ、光源としてのレーザーを点灯し、ＡＦ引き込み、及びＡＴ引き込み後、トラック追従のトレース動作をしない状態でディスクの偏心量を測定する。
【０１１４】ディスクの偏心量はキャリッジを停止した状態で、ＡＴサーボをかけているときのレンポジ信号により測定する。ディスクの回転同期カウンターにより回

転位相を知り、これに同期してディスクの偏心量を測定、記憶する。例えばディスク８回転分を平均化する。また１回転分のデータ量は１０４個程度である。この偏心量データは、トレース動作時にキャリッジが偏心に追従しないようにレンポジ信号から偏心分をキャンセルするために使用される。

【０１１５】上記図７において、ＬＰ誤差Ａ／Ｄ５１のレンポジ信号に加算器６３にてトレースオフセット６２のトレースオフセット量を加算（実際、加算は減算となる）して、ディスク回転に同期した形で偏心量を設定する。

【０１１６】つぎに、偏心量測定自動調整について説明する。自動調整時のサーボ状態は、ＡＦ、ＡＴまで引き込んだ状態で行なう。また、外部振動のない状況下では必須ではないが、外部からの振動を考慮すると、どこかにキャリッジを固定する必要がある。

【０１１７】さらに、調整手順について説明する。１１０個のデータテーブルをクリアする。５０ＫＨｚの1／４のタイミングで、ＬＰ誤差Ａ／Ｄ５１のＬＰ誤差Ａ／Ｄ値をディスクの回転同期カウンターの示す位相のテーブルに積算していく。同期カウンターが５０ＫＨｚの１／８なので各１位相で２サンプルのＬＰ誤差Ａ／Ｄ５１のＡ／Ｄ値データを獲得する。８回転分の時間が経過したら、テーブル全体に渡り平均化する。

【０１１８】まず平均化処理について説明する。ディスク回転の位相毎の平均偏心量データを求め、全位相分つまり一周分の偏心量の平均を算出する。この平均は偏心量データテーブルのＤＣ分となるから、このＤＣ分を各位相の偏心量データから減算し、ＤＣ分の無い偏心量テーブルとする。

【０１１９】以上、３種類の具体的なアルゴリズムについて説明した。いずれも、ＡＦオフセット、ＡＴオフセット、偏心量などの平均値などを求めて処理するアルゴリズムであるが、本発明はこのアルゴリズムに限定されるものではなく、他のアルゴリズムでもよい。

【０１２０】

【発明の効果】以上説明したように、本発明により、ディジタルサーボにおけるサンプリング周波数を高速化できない問題、あるいは量子化誤差の問題が解決できる。

【０１２１】シーク時とその他のときで、対物レンズの固定のためのレンポジサーボループの帯域を変更し、トラック横断時のサーボ信号の測定時に狭いレンポジサーボ帯域で、スムーズに対物レンズを意図的に振動させることより、偏心のないディスクであっても、常にトラック横断が実現でき、スムーズに動かすことで、振幅測定の精度が向上する。

【０１２２】また、ディジタルサーボでの限られたサンプリング周波数においても、サンプルタイミング毎の簡単なメモリ操作により、正確なサーボ信号の振幅を捉えることができ、振幅測定の精度が向上する。

【０１２３】また、ディジタルサーボのサンプリングタイミングに同期し、かつディスクの回転と同期した形でレンポジ信号を測定記憶することで、正確にディスクの偏心量を測定することができる。

【０１２４】これらにより高精度なサーボを実現でき、高密度、大容量な光ディスクを実現できる。また、ディスクの状態、そのときの装置状態にあった自動調整を行うことで、光学部品精度、ディスク精度、あるいは製造時の調整の精度を落とすことができ、低コストで装置を製造することができる。

【図面の簡単な説明】

【図１】本発明を実施した光磁気ディスク装置のサーボ系自動調整ブロック図である。

【図２】本発明を実施した光磁気ディスク装置のハードウエアブロック図である。

【図３】本発明を実施した光磁気ディスク装置のＡＦオフセット自動調整ブロック図である。

【図４】トラッキング信号振幅測定のフローチャートである。

【図５】図４のフローチャートの一部を詳細に示したトラッキング信号振幅測定のフローチャートである。

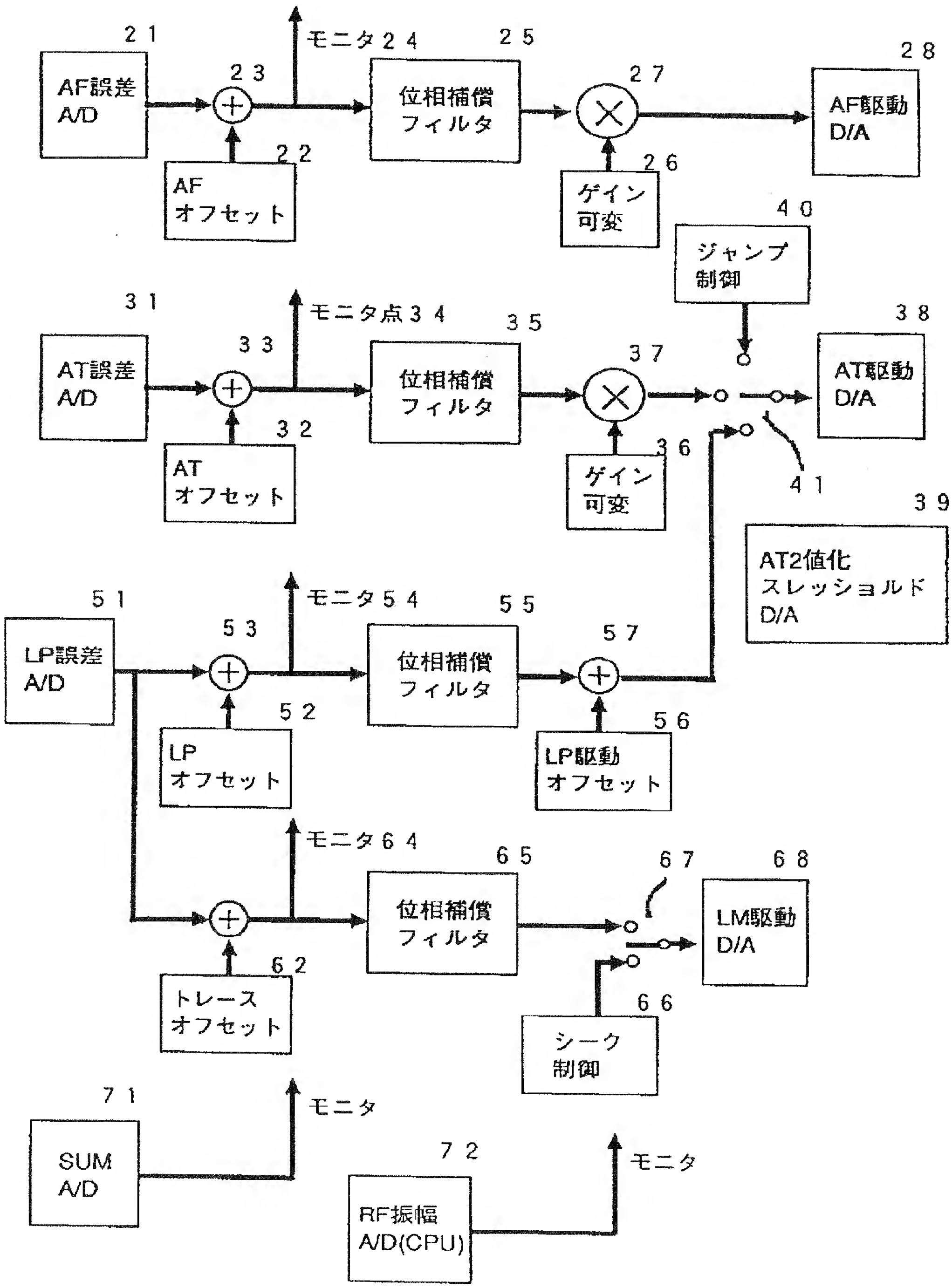
【図６】本発明を実施した光磁気ディスク装置のＡＴ＆ＳＵＭオフセット自動調整ブロック図である。

【図７】本発明を実施した光磁気ディスク装置の偏心測定ブロック図である。

【符号の説明】

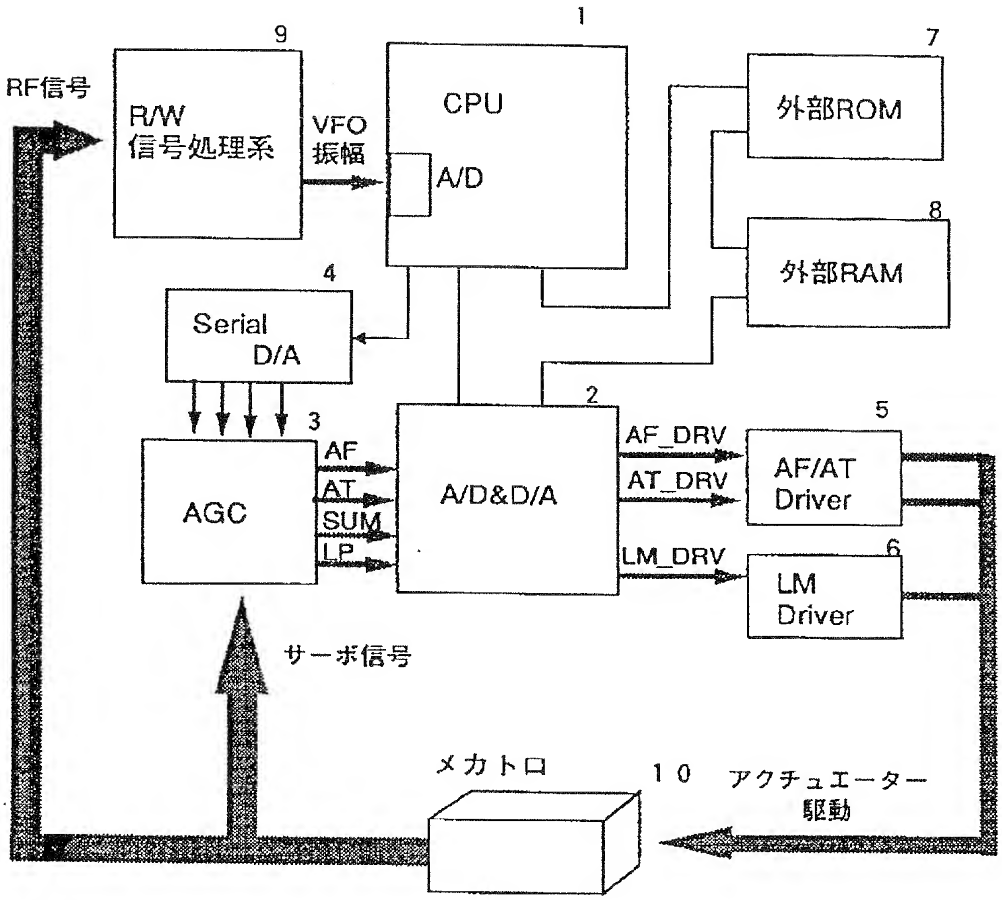
１　ＣＰＵ
２　Ａ／Ｄ＆Ｄ／Ａコンバーター
３　ＡＧＣ
５　ＡＦ／ＡＴドライバー
１０　メカトロ
２１　ＡＦ誤差Ａ／Ｄ
２２　ＡＦオフセット
２５　位相補償フィルタ
２８　ＡＦ駆動Ｄ／Ａ
３１　ＡＴ誤差Ａ／Ｄ
３２　ＡＴオフセット
３５　位相補償フィルタ
３８　ＡＴ駆動Ｄ／Ａ
５１　ＬＰ誤差Ａ／Ｄ
５６　ＬＰ駆動オフセット

【図１】



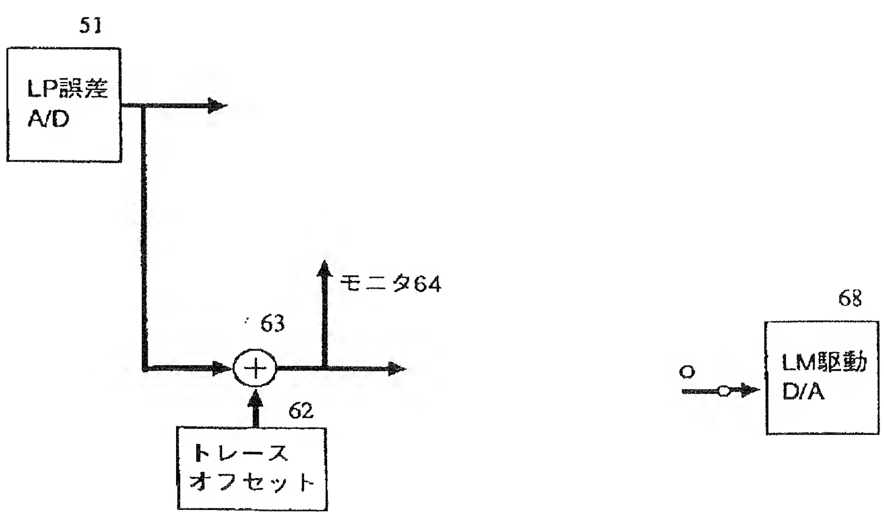
21
AF誤差 A/D
23
モニタ24
22
AF オフセット
25
位相補償 フィルタ
27
26
ゲイン 可変
28
AF駆動 D/A
40
ジャンプ 制御
31
AT誤差 A/D
33
モニタ点34
32
AT オフセット
35
位相補償 フィルタ
37
36
ゲイン 可変
38
AT駆動 D/A
41
39
AT2値化 スレッショルド D/A
51
LP誤差 A/D
53
モニタ54
52
LP オフセット
55
位相補償 フィルタ
57
56
LP駆動 オフセット
モニタ64
62
トレース オフセット
65
位相補償 フィルタ
67
68
LM駆動 D/A
66
シーク 制御
71
SUM A/D
モニタ
72
RF振幅 A/D(CPU)
モニタ

【図２】



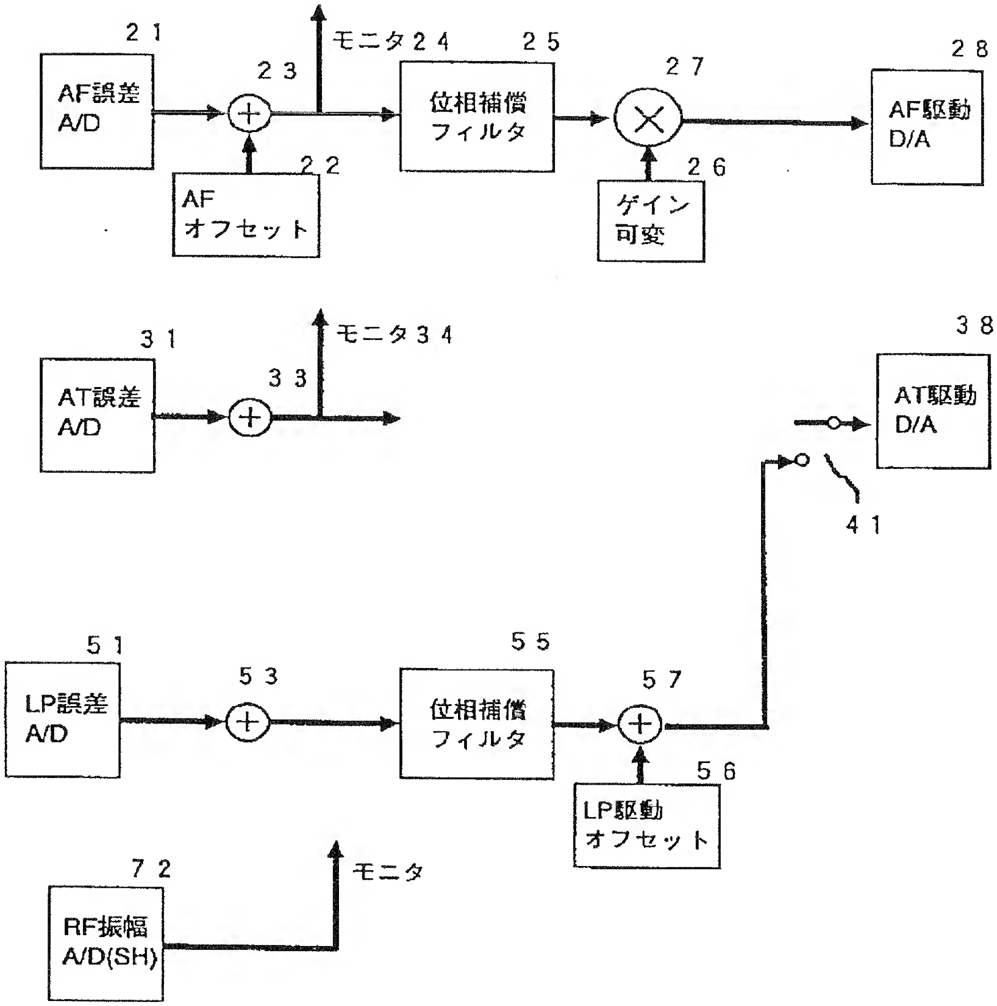
1
CPU
A/D
9
RF信号
R/W
信号処理系
VFO
振幅
7
外部ROM
8
外部RAM
4
Serial
D/A
3
AGC
AF
AT
SUM
LP
2
A/D&D/A
AF_DRV
AT_DRV
LM_DRV
5
AF/AT
Driver
6
LM
Driver
サーボ信号
メカトロ
１０
アクチュエーター
駆動

【図７】

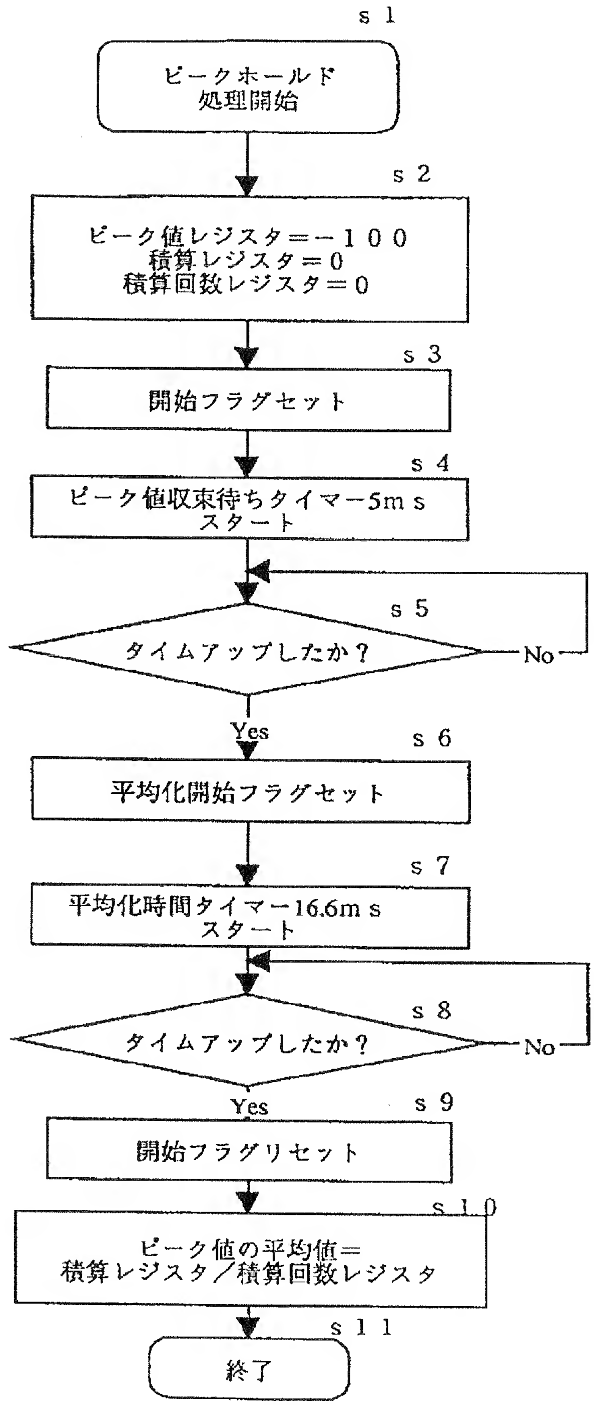


51
LP誤差
A/D
モニタ64
63
62
トレース
オフセット
68
0
LM駆動
D/A

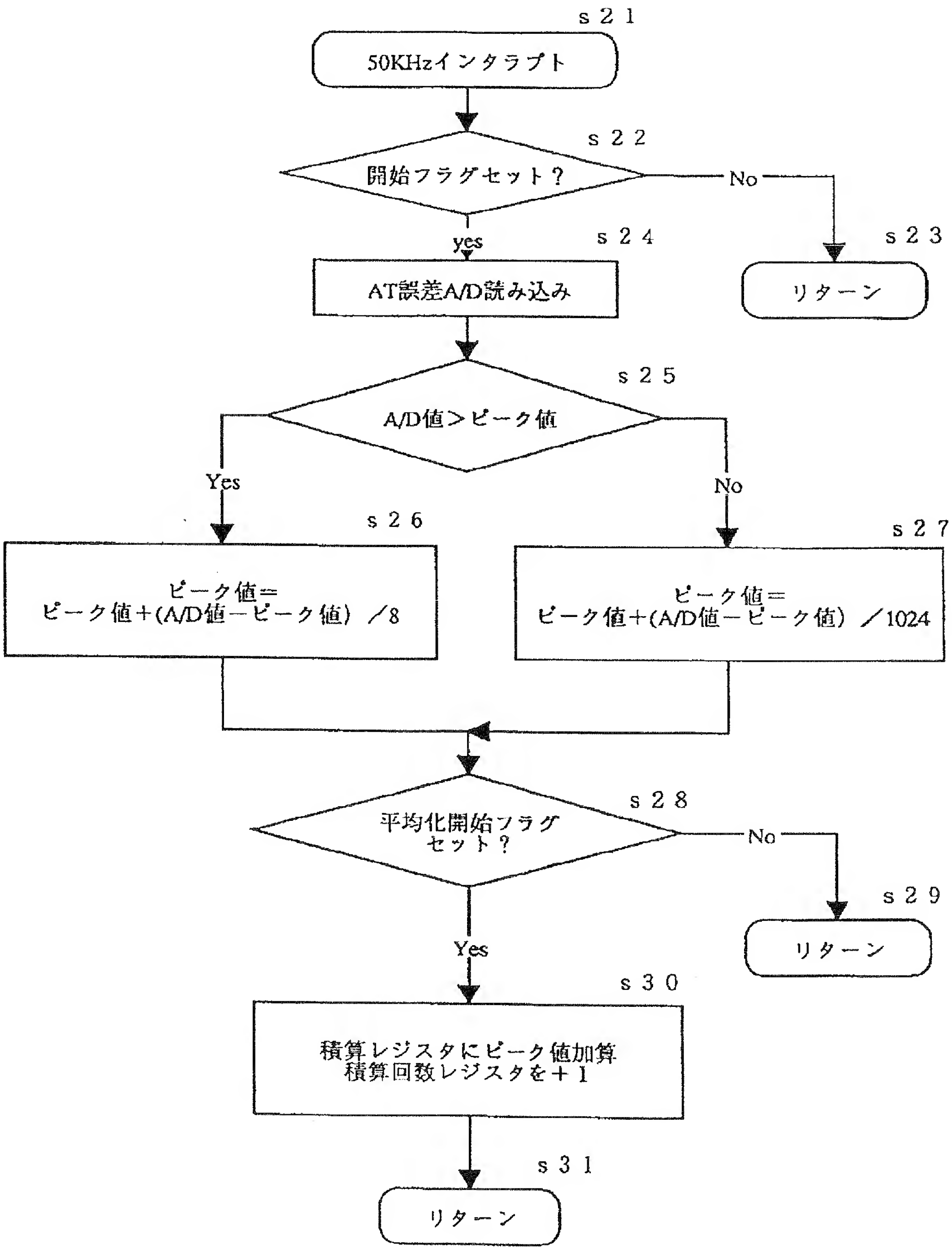
【図３】


２１
AF誤差
A/D
２３
モニタ２４
２５
位相補償
フィルタ
２７
２８
AF駆動
D/A
２２
AF
オフセット
２６
ゲイン
可変
３１
AT誤差
A/D
３３
モニタ３４
３８
AT駆動
D/A
４１
５１
LP誤差
A/D
５３
５５
位相補償
フィルタ
５７
５６
LP駆動
オフセット
７２
RF振幅
A/D(SH)
モニタ

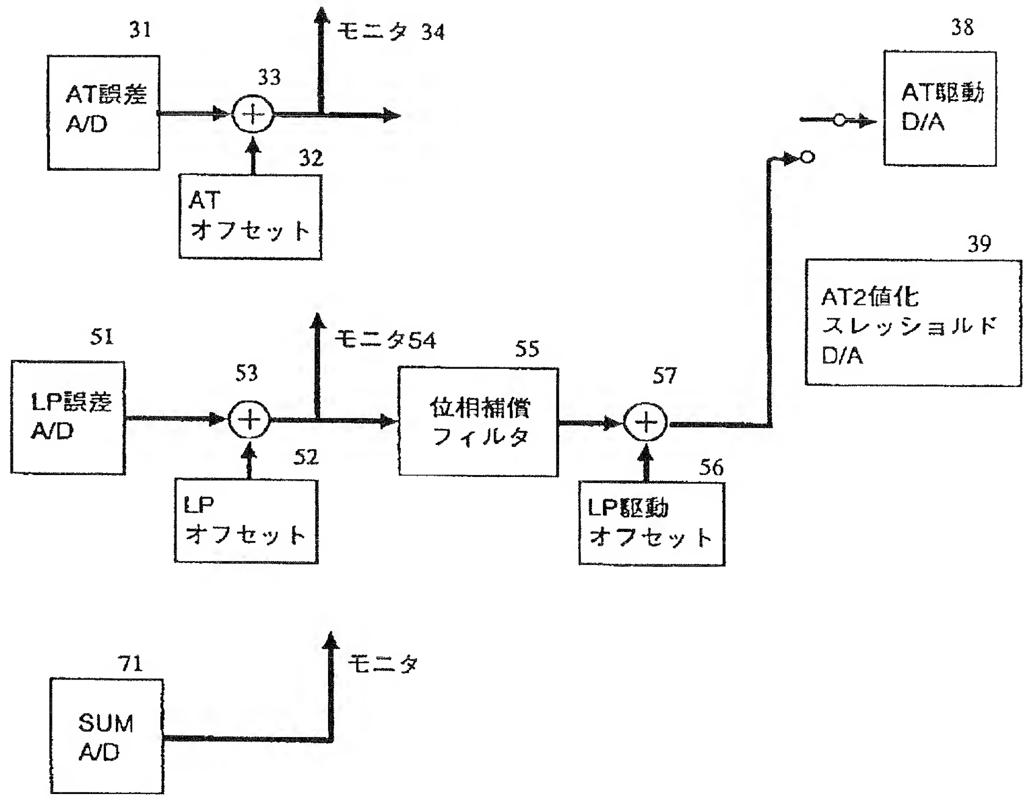
【図４】


s 1
ピークホールド
処理開始
s 2
ピーク値レジスタ＝－１００
積算レジスタ＝０
積算回数レジスタ＝０
s 3
開始フラグセット
s 4
ピーク値収束待ちタイマー5ｍｓ
スタート
s 5
タイムアップしたか？
No
Yes
s 6
平均化開始フラグセット
s 7
平均化時間タイマー16.6ｍｓ
スタート
s 8
タイムアップしたか？
No
Yes
s 9
開始フラグリセット
s １０
ピーク値の平均値＝
積算レジスタ／積算回数レジスタ
s １１
終了

【図5】


s21
50KHzインタラプト
s22
開始フラグセット？
No
s23
リターン
yes
s24
AT誤差A/D読み込み
s25
A/D値＞ピーク値
Yes
No
s26
ピーク値＝
ピーク値＋(A/D値－ピーク値）／8
s27
ピーク値＝
ピーク値＋(A/D値－ピーク値）／1024
s28
平均化開始フラグ
セット？
No
s29
リターン
Yes
s30
積算レジスタにピーク値加算
積算回数レジスタを＋1
s31
リターン

【図6】


31
AT誤差
A/D
33
モニタ 34
32
AT
オフセット
38
AT駆動
D/A
39
AT2値化
スレッショルド
D/A
51
LP誤差
A/D
53
モニタ54
52
LP
オフセット
55
位相補償
フィルタ
57
56
LP駆動
オフセット
71
SUM
A/D
モニタ

CLAIMS

[Claim(s)]

[Claim 1] In the optical information record regenerative apparatus which irradiates a light beam and performs informational record playback to the record medium which has two or more identifiable code tracks optically The 1st actuator made to move the location of the spot of said light beam in the direction which crosses said code track, The 2nd actuator made to move said 1st actuator in the direction which carries said 1st actuator and crosses said code track, A seeking means to move to a movement magnitude detection means to detect the movement magnitude of said 1st actuator, and the code track aiming at said light beam, using said 2nd actuator, At the time of seeking which drives said 1st actuator with the output of said movement magnitude detection means working [said seeking means], and holds said 1st actuator, a maintenance means, Said 1st actuator is driven with the output of said movement magnitude detection means in addition to [of said seeking means] working. The optical information record regenerative apparatus characterized by having an actuator maintenance means to hold said 1st actuator, and making the control-loop band of said actuator maintenance means narrower than the control-loop band of a maintenance means at the time of said seeking.

[Claim 2] A truck error detection means by which the reflected light from said record medium detects the amount of location gaps of the spot location of a light beam, and said code track in the first half, An amplitude measurement means to measure the signal amplitude of the output of said truck error detection means, At the time of the amplitude measurement which drives said 1st actuator with the output of said movement magnitude detection means working [said amplitude measurement means], and holds said 1st actuator, a maintenance means, The optical information record regenerative apparatus of the application for patent characterized by making the control-loop band of a maintenance means narrower than the control-loop band of a maintenance means at the time of said seeking at the time of said amplitude measurement given in the 1st term of the range.

[Claim 3] In the optical information record regenerative apparatus which irradiates a light beam and performs informational record playback to the record medium which has two or more identifiable code tracks optically By the actuator made to move the location of the spot of said light beam in the direction which crosses said code track, and the reflected light from said record medium A truck error detection means to detect the amount of location gaps of the spot location of a light beam, and said code track in the first half, The sampling means which carries out the sample of the output of said truck error detection means a predetermined sample period, A servo control means to calculate the output of said sampling means said predetermined sample period, and to drive said actuator said predetermined sample period, The output of said sampling means is processed said predetermined sample period. In having a measurement means to measure the output of said truck error detection means and making said code track adjust the location of the spot of said light beam, it operates said servo control means. The optical information record regenerative apparatus characterized by operating said measurement means in measuring the output of said truck error detection means.

[Claim 4] Said measurement means is an optical information record regenerative apparatus according to claim 3 characterized by having the memory for measuring the amplitude of said

truck error detection means, comparing the output value of said sampling means with the value of said memory said predetermined sample period, and changing the numerical variation of said memory according to a comparison result.
[Claim 5] Said numerical variation is an optical information record regenerative apparatus according to claim 4 characterized by being an amount proportional to the difference of the output value of said sampling means, and the value of said memory.
[Claim 6] In the optical information record regenerative apparatus which irradiates a light beam and performs informational record playback to the record medium which has two or more identifiable code tracks optically The 1st actuator made to move the location of the spot of said light beam in the direction which crosses said code track, The 2nd actuator made to move said 1st actuator in the direction which carries said 1st actuator and crosses said code track, By movement magnitude detection means to detect the movement magnitude of said 1st actuator, and the reflected light from said record medium A truck error detection means to detect the amount of location gaps of the spot location of a light beam, and said code track in the first half, The 1st sampling means which carries out the sample of the output of said truck error detection means a predetermined sample period, A servo control means to calculate the output of said 1st sampling means said predetermined sample period, and to drive said 1st and 2nd actuators said predetermined sample period, With the output of the 2nd sampling means which samples the output of a movement magnitude detection means with the period more than said predetermined sample period, and said 2nd sampling means The optical information record regenerative apparatus characterized by operating said servo control means and operating said movement magnitude measurement means to coincidence where it has a movement magnitude measurement means to measure the movement magnitude of said 1st actuator and said 2nd actuator is stopped.
[Claim 7] It is the optical information record regenerative apparatus according to claim 6 which has the rotation phase counter which shows the rotation phase of the motor made to rotate said record medium and said motor, and is characterized by said movement magnitude measurement means measuring said movement magnitude synchronizing with the value of said rotation phase counter.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] About the optical information record regenerative apparatus which performs informational record playback to an information record medium using a laser beam, especially, this invention establishes a truck slot in the record medium of the shape of the shape of a disk, and a card, and relates to control of the laser-beam spot of the equipment which performs informational record playback along this truck.
[0002]
[A Prior art and a background] In an optical disk unit, with an objective lens, the semiconductor laser as the light source narrows down the light which carries out outgoing radiation to the diameter of about 1 micron, and irradiates it on an optical disk.
[0003] In order to make this optical spot narrowed down small focus on the information record-medium side of an optical disk, the feedback loop control usually called a focusing servo is used.
[0004] Moreover, in order to position an optical spot to the code track on a medium side, the feedback loop control called a tracking servo is used.
[0005] These control loops consist of objective lens actuators which convert the power of the output of the amplifier 3. amplifier which amplifies the output of the photosensor 2. photosensor which usually receives the reflected light of the following elements and 1. disk with the control stabilization compensator 4. control stabilization compensator pressed down on predetermined level, and drive it.
[0006] The direction position error of a focus of an optical spot and an optical disk side is detected, an objective lens is moved to the perpendicular direction of an optical disk side with an actuator, and an optical spot is controlled by the quantity of light which receives light with the above-mentioned photosensor on a disk side.
[0007] The direction position error of a truck of the truck on a disk and an optical spot is detected, an objective lens is moved along an optical disk side with an actuator, and an optical spot is controlled by the quantity of light which receives light with a photosensor similarly on a truck.
[0008]
[Problem(s) to be Solved by the Invention] However, offset occurs to the position error signal of the direction of a focus, and the direction of a truck according to offset, an installation error of an optic, etc. which an electrical circuit has in actual equipment, and it has been the failure of construction of servo system with a high precision. For this reason, how to adjust offset of a position error signal automatically at the time of starting of equipment etc. is considered. Many of these approaches add how many kinds of those offset intentionally in a servo loop, and it is searching for offset amendment from which the best signal is acquired. For example, sequential impression of about 20 steps of the offset is carried out at a focal servo loop, and the amplitude of a tracking signal is measured, the offset which gives the greatest tracking error signal amplitude is found out, and it adds to a servo loop by considering this as adjustment offset.
[0009] Moreover, aiming at the miniaturization of equipment, low-cost-izing, and high-performance-izing, digitization of the servo circuit of an optical disk is performed briskly in

recent years. In a digital servo, A/D conversion of the position error signal acquired from the photosensor is carried out, the amount of position errors is evaluated, this numeric value is calculated by the digital circuit, the microprocessor, DSP (digital signal processor), etc., and the configuration which drives an actuator as a proper driving signal is taken. Although it surely becomes a discrete time control in a digital servo, sample spacing cannot be recklessly made minutely high in this case from the relation of A/D-conversion time amount and digital-signal-processing time amount.
[0010] For example, even in the tracking servo which needs the fastest processing in an optical disk unit, it becomes the sampling frequency of at most about 50kHz.
[0011] Then, when performing a digital servo, measurement of the signal amplitude for the automatic adjustment at the time of equipment starting becomes difficult for this low sampling frequency. That is, since the highest frequency of truck crossing by the eccentricity of a disk is set to 5kHz - about 10kHz when it is going to measure a tracking error signal, in the sampling frequency of 50kHz, only 10 sample point can be acquired from per [5] truck crossing wave round term. Now, the amplitude value of a truck crossing signal or offset cannot be measured correctly.
[0012] Moreover, as for truck crossing by disk eccentricity, an optical spot goes to the truck (correctly twice) for eccentricity and comes back by one disk revolution. The moment the crossing direction is reversed, a tracking error signal cannot reach to amplitude value, and the amplitude of a truck crossing signal and offset cannot be too measured correctly with a peak with a halfway value.
[0013] Therefore, although a policy which supervises the frequency of a truck crossing signal and forbids measurement on a low frequency and a high frequency was also considered, in order to raise the accuracy of measurement, a measurement authorization frequency could not be made large, but increase of adjustment time amount was caused. Moreover, for the reason, adjustment precision also needed to reach a compromise to some extent, and had dropped controllability ability.
[0014] Moreover, although it is necessary to make immobilization or a consciousness target move an objective lens at the time of above-mentioned truck crossing signal amplitude measurement, for that, the location of an objective lens is measured and feedback control is performed to a tracking actuator. On the other hand, in order to reproduce or record information required as an optical disk unit, at the time of seeking which moves a light beam to a desired truck, it is necessary to fix so that this objective lens may not be shaken by vibration by seeking migration. However, in immobilization of the objective lens at the time of seeking, since vibration by seeking migration is large, it is necessary to make high the Ford back gain of this objective lens immobilization. Therefore, in the objective lens fixed feedback control at the time of truck crossing signal amplitude measurement, the driving force by the quantization error which surely remains by digital control is greatly impressed to an actuator, and an objective lens vibrates minutely. Therefore, highly precise truck crossing signal amplitude measurement was difficult.
[0015] Moreover, when carried out by the 50kHz same to measurement of the eccentricity of a disk as the sampling frequency of a tracking servo, when the eccentricity data for disk 1 rotation were memorized, 833 memory was needed as 3600rpm, the rotational frequency occupied the part with precious big memory which it has, such as CPU, and memory effectiveness was very bad.
[0016]
[Means for Solving the Problem and its Function] It is what was made in order that this invention might solve the fault and trouble of the above-mentioned versatility. In the optical information record regenerative apparatus which irradiates a light beam and performs informational record playback to the record medium which has two or more identifiable code tracks optically The 1st actuator made to move the location of the spot of a light beam in the direction which crosses a code track, The 2nd actuator made to move the 1st actuator in the direction which carries this 1st actuator and crosses a code track, A seeking means to move to a movement magnitude detection means to detect the movement magnitude of the 1st actuator, and the code track aiming at a light beam, using the 2nd actuator, The 1st actuator is driven with the output of a

movement magnitude detection means working [a seeking means]. Have a maintenance means at the time of seeking holding the 1st actuator, and the 1st actuator is driven with the output of a movement magnitude detection means in addition to [of a seeking means] working. It has an actuator maintenance means to hold the 1st actuator, and is characterized by making the control-loop band of an actuator maintenance means narrower than the control-loop band of a maintenance means at the time of seeking.
[0017] Furthermore, a truck error detection means by which the reflected light from a record medium detects the amount of location gaps of the spot location of a light beam, and a code track, The output of a truck error detection means Processing is performed for the output of a servo control means to perform an operation for the output of a sampling means and a sampling means which carries out a sample a predetermined sample period a predetermined sample period, and to drive an actuator a predetermined sample period, and a sampling means, a predetermined sample period. It has a measurement means to measure the output of a truck error detection means, in making a truck adjust the location of the spot of a light beam, it operates a servo control means, and in measuring the output of a truck error detection means, it operates a measurement means.
[0018] Furthermore, the trouble from the former is solved in operating a servo control means and operating a movement magnitude measurement means to coincidence, where the 2nd actuator is stopped with a movement magnitude measurement means to measure the movement magnitude of the 1st actuator, with the output of the 2nd sampling means which samples the output of a movement magnitude detection means, and the 2nd sampling means with the period beyond a predetermined sample synchronization.
[0019] Moreover, in the information record regenerative apparatus which irradiates a light beam and performs informational record playback to the record medium which has two or more identifiable code tracks optically, it has an error signal detection means to detect a tracking error signal, and a tracking servo means to irradiate a light beam and to follow an objective lens in a code track, and is characterized by making the band of the tracking control loop at the time of playback narrower than the band of the tracking control loop at the time of seeking. Then, at the time of playback, it follows correctly by the precise servo loop, and an early jump action can be attained at the time of seeking.
[0020]
[Example] The outline of the whole in regulating automatically, such as offset of the optical information record regenerative apparatus by this invention, is explained.
[0021] (1) The block diagram of the hardware of optical-magnetic disc equipment servo system which carried out this invention to hardware configuration drawing 2 is shown. The light source for 10 being mechatronics, and an optical disk being inserted in drawing, and carrying out record playback according to the truck of an optical disk, The optical system of an objective lens, the sensor for signal processing, etc., and the electric system which processes the signal, The mechanical system of the actuator which operates mechanically, a spindle motor, etc. is built in. 9 is the R/W signal-processing system of reading from the RF signal which is an output signal from mechatronics 10, modulating write-in data or outputting a VFO amplitude signal. [restoring to a signal] 1 is CPU, the whole system containing hardware is controlled, the VFO amplitude signal from the R/W signal-processing system 9 is processed, and 4 is serial D/A. 3 is AGC which carries out control magnification of the amplitude of servo signals, such as an output of the focal error signal and tracking error signal of mechatronics 10, and serial D/A. 2 is the A/D& D/A converter which carries out D/A conversion of the electrical-potential-difference data according to CPU1 in carrying out A/D conversion of the output of AGC3 ****, and performs signal transformation between analog-to-digital one. 5 is the AF/AT driver which carries out power amplification of the drive signal of the automatic focus tracking from A/D& D/A converter 2, and drives an actuator. 6 is a LM driver who amplifies the drive signal for linear motors which moves the location of the pickup from A/D& D/A converter 2. The exterior ROM 7 and the exterior RAM 8 are memory which memorizes the program used by the memory in CPU1 when insufficient, and temporary data.
[0022] Servo processing of this example is a software servo by CPU1. It is performing also

regulating [of servo system] automatically by the firmware processing in almost all the parts CPU 1. Since a setup of the threshold level of the comparator for a truck count which is not illustrated which needs rapidity, and offset adjustment of AGC3 cannot be processed within CPU1, the electrical potential difference has been set to the external device besides CPU1 with serial D/A converter 4. Hereafter, it explains, illustrating the detail of each part.
[0023] (2) Since high-speed processing is possible, the whole system is controlled by CPU1RISC (Reduced Instruction Set Computer) type CPU and the hardware multiplier is built in, 16*16=32 bit multiplication can perform in 150ns, and builds in the A/D converter of 8 bits and 8ch.
[0024] (3) All the channel conversion times of 28 bit A/D of A/D& D/A converters are 1.7microS by time sharing at the time of 8ch input and 8ch scan actuation. 8-bit D/A has 4ch output and the settling time for about 3 microseconds.
[0025] (4) It has serial D/A4 serial-communication form 12ch and a 8-bit D/A converter. The settling times are 300 microseconds and a low speed.
[0026] (5) Receive servo sensor output 8ch from AGC3 mechatronics 10, and while generating each servo signals, such as (Focus AF) error signal / (Tracking AT) error signal / the total quantity of light (SUM) signal, perform normalization (AGC) actuation of each servo signal. Moreover, a lens position sensor output is received from mechatronics 10, a lens position (REMPOJI) signal is generated, and APC is applied to REMPOJI LED which detects a lens position.
[0027] (6) Carry out 2ch possession in portions of the AF/AT driver 5 bridge-type output-power operational amplifier, it consists of power amplifier for automatic focus auto tracking, and the maximum drive current to an actuator is 0.7A.
[0028] (7) With the driver of the linear motor which sets up a LM driver 6 lens position, it is the driver which drives a voice coil and has maximum output 2A.
[0029] (8) Although there are built-in ROM and RAM in the exterior ROM 7 and external RAM8CPU1, since storage capacity runs short, also outside, it has memory. It is used by possible processing also at the low speed which is mainly neither an object for the processing sections of a system-control system, nor the real-time operation of a servo. Needing a big memory area, even if it is a regulating system, the part which seldom requires rapidity uses Exterior RAM.
[0030] (9) Restore to it and output the regenerative signal from mechatronics 10 in the part for processing of R/W signal-processing 9 RF signal, modulate the signal data recorded on the optical disk of mechatronics 10 by the RF, and output to the electric system and optical system in mechatronics. The signal-processing section which generates the hold value of the VFO amplitude required for regulating [of AF offset] automatically is also constituted.
[0031] (10) It is the abbreviated-name mechatronics of mechanical electronics which can equip with mechatronics 10, for example, a 3.5 inch magneto-optic disk. It consists of a head of the usual magneto-optic disk, a spindle motor for disk rotation, etc. The objective lens which there is an optical head same separation optical type [the] as what is carried in the usual optical-magnetic disc equipment, and is carried in mechatronics 10 at the carriage which is a part for moving part is movable in the direction of a focus, and the direction of tracking. A focus servo and a tracking servo are performed by moving this objective lens. Moreover, carriage and the sensor for lens positions which detects the relative location of the direction of tracking of an objective lens are formed, since carriage is driven at the time of tracking, it is used, or it is used for location immobilization of the objective lens under seeking. Since an objective lens location sensor, a call, and a lens position are detected, this sensor is also called a "REMPOJI" sensor. The detection approach of this sensor fixes an optical light emitting-receiving element called a photo interrupter to the carriage section, and can realize it by putting the gobo which engaged with the objective lens on the optical path of a photo interrupter. A linear motor is carried in this carriage section, and it operates as the 2nd actuator.
[0032] The signal from the optical head which is in mechatronics 10 part by the configuration of each part of the above turns into a servo signal which AGC3 normalized, and digitizes this servo signal with the A/D converter of A/D& D/A converter 2.
[0033] If a focal servo loop is explained, A/D conversion of the focal error signal (drawing AF)

outputted from AGC3 will be carried out, and it will consider as digital value. And based on this digital value, the filter operation of servo loop stabilization is performed by CPU1, the result of an operation is outputted to the D/A converter of A/D& D/A converter 2, and the focusing actuator in mechatronics 10 is driven to an analog signal with AF driver amplifier of conversion (drawing AF DRV), and the AF / AT driver 5.
[0034] Similarly, a tracking loop formation also processes the tracking error signal (drawing AT) outputted from AGC3, and is constituted, and it is AT. The signal outputted as DRV drives the tracking actuator in mechatronics 10 with AT driver amplifier of the AF/AT driver 5. [as well as a focal servo loop] These details are clarified by the below-mentioned explanation.
[0035] The block diagram of the servo-system function in the example of this invention is shown in drawing 1 .
[0036] Many regulating [of servo system] automatically are adjusted on the digital numeric-value level of the CPU1 interior. Serial D/A4 which is the exterior a part is used.
[0037] (A) It is inputted into the A/D-converter part of A/D& D/A converter 2 from the focus servo system AGC 3, and the data changed into digital value are shown as AF error A / a D value of the AF error A/D block 21. AF error A / D value output of the AF error A/D block 21 are added with the data and the adder 23 of the AF offset 22, and serves as AF error data by which offset adjustment was carried out. The data shown with the monitor point 24 which is the output of this adder 23 serve as a base of AF error signal, and the error signal for a focus servo or a focus shifts, and is used for monitors, such as detection.
[0038] In regulating actuation, it shakes in order to set the value of the data of this AF offset 22 as actually various values and to try it, and the monitor of the amplitude of AT error signal or the amplitude of a RF signal is carried out, and the focal best point is found.
[0039] At least the data shown with the monitor point 24 are calculated with the phase compensating filter 25, the multiplication of this data is carried out with the adjustable control signal and multiplier 27 of the variable gain adjustable block 26 for loop-gain adjustment, and it is outputted to AF drive D/A converter section 28 of A/D& D/A converter 2.
[0040] (B) It is the configuration same on a tracking servo system basic target as a focus servo system. It is inputted into the A/D-converter part of A/D& D/A converter 2 from AGC3, and the data changed into digital value are shown as an output of the AT error A/D block 31. The output of the AT error A/D block 31 is added with the AT offset data 32 and an adder 33, and serves as AT error data by which offset adjustment was carried out. The AT offset 32 performs amendment of the offset by the lens location besides DC-offset.
[0041] In regulating actuation, offset is measured with the signal amplitude at the time of truck crossing which appears in the monitor point 34 when making AT offset into zero. According to that measured value, AT offset value of the AT offset 32 is determined, at least the data shown with the monitor point 34 are calculated with the phase compensating filter 35, the multiplication of this data is carried out with the adjustable control signal and multiplier 37 of the variable gain adjustable block 36 for loop-gain adjustment, and it is outputted to AT drive D/A converter section 38 of A/D& D/A converter 2. The threshold level value of AT binary-ized threshold level D/A39 is set up in that case.
[0042] AT actuator needs to receive the drive of the jump control 40 and REMPOJI servo drive other than a tracking servo, and has expressed it with a switch 41 by a diagram. Output of the switch 41 A power drive is carried out by AT drive D/A38, and AT actuator is driven.
[0043] (C) Like a REMPOJI servo-system focus servo system, LP output which shows the lens position of AGC3 is digitized in the A/D-converter part of A/D& D/A converter 2, and is used as the data of REMPOJI error A/D51, and LP offset value of the LP offset 52 is added to it with an adder 53 by the first rank, and it serves as data of the REMPOJI monitor point 54. Next, the phase compensating filter 55 performs an amendment operation, and LP drive offset value from LP drive offset 56 is further added with an adder 57, and it is referred to as adjusted REMPOJI data at various functional modules. Here, since gain precision is not required, unlike a focus servo system, a gain adjustment is not performed.
[0044] In order to make a truck cross compulsorily in the case of measurement of the amplitude of AT error signal, the drive offset 56 of low frequency is added to the output stage of a

REMPOJI servo with an adder 57 as drive offset data, and the objective lens is vibrated.
[0045] (D) The trace offset value by the trace offset 62 is added to the data of trace servo-system REMPOJI error A/D51 with an adder 63, they are adjusted, and it considers as the monitor point 64, and an amendment operation is carried out with the phase compensating filter 65, and at least a degree is outputted as an analog value by LM drive D/A68 for linear motors, and is used for various functional modules.
[0046] The trace offset 62 has the function which cancels a part for the eccentricity at the time of disk rotation. The spindle rotation synchronous counter counted 1 rotation 100 count extent every synchronizing with rotation of the spindle motor of a disk rotation motor is constituted in CPU1, the trace offset data which is equivalent to a part for eccentricity synchronizing with a spindle rotation synchronous counter at the time of trace is updated, and it becomes the REMPOJI signal with which the eccentric component was removed at the monitor point 64.
[0047] The switch 67 has realized the switch with the output of the phase compensating filter 65, and the seeking control block 66 like AT servo. And the output of a switch 67 drives the linear motor which is inputted into LM drive D/A68 and moves the location of optical system.
[0048] (E) Call a SUM signal the signal adding all the outputs of the servo sensor divided into SUM signal system plurality. A SUM signal is digital-data-ized in the A/D section of A/D& D/A converter 2, the threshold level data of binary-izing of a SUM signal are determined, or AF by the SUM signal shifts and determines detection threshold level data.
[0049] [Explanation of each algorithm] Eccentricity measurement is hereafter explained further to a detail, respectively about a coarse control [in / level / the coarse control in AF offset, fine tuning, and / blank detection / AT&SUM offset], slice level, and blank detection level.
[0050] (1) AF offset (a coarse control, fine tuning, blank detection level)
In a regulating functional block diagram (drawing 1), a part required for especially AF offset regulating automatically is extracted and shown in drawing 3 .
[0051] Focal offset regulating automatically is roughly divided into two regulating automatically. One is the offset adjustment which made the amplitude of a tracking error signal the index, and another is the offset adjustment which made the amplitude of an ID section VFO signal the index. The former is called "AF offset regulating automatically by AT signal amplitude", and the latter is called "AF offset adjustment by the VFO amplitude."
[0052] A disk is rotated with constant speed and it performs "AF offset regulating automatically by AT signal amplitude" after laser lighting and AF drawing in. Then, "AF offset adjustment by the VFO amplitude" is performed in the state of AT drawing in and trace. These two regulating automatically are independent modules, and if it performs all regulating automatically, finally AF offset by "AF offset adjustment by the VFO amplitude" will be set up.
[0053] By combining these two AF regulating automatically, it can build AF offset regulating [which can respond] automatically to some differences of AT-Max and VFO-Max. For example, "AF offset regulating automatically by AT signal amplitude" restricts the amount of actually shaken AF offset. Or middle level of the offset value of "AF offset regulating automatically by AT signal amplitude" and the offset value in "AF offset adjustment by the VFO amplitude" is considered as last setting AF offset.
[0054] Next, detailed explanation of this "AF offset regulating automatically by AT signal amplitude" automatically and "AF offset adjustment by the VFO amplitude" is given.
[0055] (a) AF offset regulating" by "AT signal amplitude
First, the servo condition at the time of regulating automatically is explained. It is in the condition which started to AF servo, and AT actuator for tracking servo adjustment performs offset regulating [of a focus servo] automatically in the condition of having been held in the center by the REMPOJI servo.
[0056] In a disk signal side, according to the 3 beam method, the spot for tracking is arranged in the location [every / one side / of one truck] deviated, the photosensor for tracking detection receives the primary [**] light of both sides, and the difference of a sensor output signal serves as AT signal, for example. Moreover, the photosensor of quadrisection of the reflected wave by the beam of 2 division receives the push pull method, and it makes a tracking error signal AT signal. ****** of AT servo controls the location of an objective lens so that the difference of a

sensor output signal becomes zero.
[0057] The amplitude of AT signal receives effect by the function of AGC3. If the normalization speed of response of AGC3 is made high, a strain will arise to AT signal under the effect of a sum signal. For this reason, it is necessary to carry out the peak hold of the normalization signal, i.e., sum signal, of AGC3. Detection of AT signal amplitude needs to be in this peak hold condition.
[0058] Although AT actuator is mostly fixed in the center of the movable range by the REMPOJI servo, in order to guarantee that an optical spot crosses a truck at this time, an objective lens is vibrated very small. The driving signal of the fixed period of a sine wave is given to a REMPOJI servo loop, and an objective lens is vibrated. For example, the period of about 100Hz and vibration of about about ten micrometers are generated. As LP drive offset 56, the signal of the LP offset 52 is added to this driving signal by the output of LP error A/D51 of drawing 3 with an adder 53, and phase compensation is carried out with the phase compensating filter 55, and it is added just before the output to AT drive D/A38 of a REMPOJI servo like the configuration that the output signal of LP drive offset 56 can be applied with an adder 57. This is the problem of the quantization error by the digital signal of a REMPOJI servo, and is because vibration with smoother adding a signal just before the output to AT drive D/A38 can be carried out by adding a sine wave as desired value of a REMPOJI servo loop.
[0059] Moreover, it is necessary to set up the band of a REMPOJI servo narrowly for a smooth vibration. On the other hand, since the REMPOJI servo under seeking needs to suppress vibration of the objective lens under seeking as much as possible, it is large in a band, that is, needs to make gain high. Therefore, the large band of the REMPOJI servo under seeking by jump control of a code track is taken, and the configuration which narrows the band of a REMPOJI servo in the time of others is taken. This becomes possible because at least that in CPU1 changes the gain and the filter shape of the phase compensating filter 55 by the time of seeking, and the case of being other. In the software servo by the program memorized by ROM which used CPU1, doing in this way does not have any evil, and it is easily realizable.
[0060] By taking the large band of the REMPOJI servo under seeking, and narrowing the band of a REMPOJI servo in the time of others, during seeking, vibration of an objective lens can be suppressed as much as possible, the error resulting from vibration of the location of the objective lens detected by the truck count and the objective lens of passing speed is abolished, and stable seeking is enabled.
[0061] Moreover, by narrowing a REMPOJI servo band at the time of AF offset regulating automatically, the strain of the signal wave form by unnecessary vibration is lost, and the amplitude measurement precision of AT signal can be raised with moving smoothly [can move an objective lens smoothly, and a disk without eccentricity can also make truck crossing, and].
[0062] Furthermore, by narrowing REMPOJI servo bands other than the time of seeking, it can consider as the configuration which does not give driving force to an actuator superfluously, power consumption can be reduced, and generation of heat of an actuator can be suppressed.
[0063] Below, the adjustment procedure of AF offset regulating automatically by AT signal amplitude is explained. The amplitude range of offset impressed to AF servo loop for adjustment is decided based on the peak value data of the AF-S character as an output wave of AF error signal measured at the time of AF drawing in. For example, it considers as half [of a S character peak]. Offset is changed with the resolution which divided the one half of this S character peak into eight equally. It measures 17 point by plus minus both directions and the zero point.
[0064] First, as offset zero, the amplitude of AT signal is measured, and the amplitude value and offset value are associated and memorized. Next, it changes one step of offset at a time in the minus direction with the above-mentioned resolution, and AT signal amplitude value in each step and the given offset are associated and memorized. This is performed to within the limits of said range, i.e., eight steps.
[0065] Moreover, it is parallel at this time and maximum distinction of AT signal amplitude is performed, and when AT signal amplitude which is less than 80% of maximum during each step measurement is measured, the sequence which does not enlarge the absolute value of offset any more is taken. This is for preventing a focus condition's deteriorating extremely and a focus

separating.
[0066] Next, again, offset is changed to zero and a plus direction is shortly measured like the minus direction.
[0067] If measurement of all the points is completed, the maximum of AT signal amplitude value will be found. And AF offset which gives 80% of amplitude of maximum is computed. The offset value which is below these 80% is calculated by the linear interpolation from the offset value of order.
[0068] it considers as setting offset, an average, i.e., the center, of each plus direction and minus direction [80% of] fall offset.
[0069] Finally, offset is gradually changed to the setting offset. Since a focus causes a gap, an abrupt change's is not good. Moreover, a focus should just set up the offset value which shifts and cuts the 80 above-mentioned% as threshold level of detection.
[0070] Next, the AT signal amplitude measurement approach is explained. Fundamentally, it carries out in a peak hold and bottom hold actuation. Attack/hold property is set up so that the average value of peak value or a bottom value can be measured correctly, and so that a noise may not be answered steeply. Under the present circumstances, let one half of the difference of a peak and a bottom be the amplitude. And it processes to 50kHz servo interrupt timing. Reading the output value of AT error A/D31, according to the size relation of difference with peak data or bottom data, an attack property subtracts one eighth of difference, and addition and a hold property are subtracting 1/1024 of difference.
[0071] It is parallel to the above processing, and a peak / bottom data is integrated and equalized for every 50kHz sample. For example, the data between 16.6ms of one-revolution parts per one point of impression focus offset at the time of measurement are averaged.
[0072] Below, a flow chart is used and explained. As well as drawing 5 , the flow chart of an interrupt module is shown for the flow chart which becomes main [AT signal amplitude measurement by this invention] in drawing 4 .
[0073] For example, suppose that AT signal amplitude at the time of truck crossing was **100. Although the detection approach of the peak value which is +100 side is explained here, since the detection approach of the negative peak by the side of -100 (bottom) is also easily realizable only by taking a sign or size relation into consideration, explanation is omitted.
[0074] Peak hold processing is started at step 1 (s1). The register for equalization or the register of wave-like peak value is initialized first (s1). The register of peak value is a register used as the output of peak hold processing of AT error signal, and an addition register is an addition register for equalizing a peak hold value by fixed period. The count register of addition shows the count which integrated the peak hold value to the addition register. Therefore, average peak value is computable by "value of addition register"/"the value of the count register of addition."
[0075] In step s3, if a beginning flag is set, the peak hold processing in the interrupt processing explained by drawing 5 later will begin.
[0076] At step s4, in order to carry out time amount waiting until a peak value register converges on actual peak value from initial value, the timer for 5ms is started.
[0077] It judges that 5ms passed at step s5, and then an equalization beginning flag is set at step s6. After this, within the interrupt processing shown in drawing 5 , peak hold processing is performed succeedingly and addition processing of peak value is started further.
[0078] The timer which sets up the time amount equalized in step s7 is started, and it is made the time-average-ized thing for 16.6ms for disk 1 rotation here. Dispersion in the hoop direction of a disk can also be equalized by equalizing during disk 1 rotation.
[0079] If the progress for 16.6ms is judged at step s8, a beginning flag will be reset at step s9, and the peak hold within interrupt processing and addition processing will be suspended.
[0080] Then, the average is calculated at step s10. By breaking the value of an addition register by the value of the count register of addition, the peak value of an average of the average AT signal amplitude between disk 1 rotations is computable.
[0081] Next, an interrupt processing module is explained using drawing 5 .
[0082] This interrupt processing is started by 50kHz which is the basic sample frequency of servo system. If this module starts within interrupt processing, it will be confirmed first whether

the beginning flag has left in step s22. It goes to the return of step s23 until a beginning flag s3 is set with the Maine flow chart of drawing 4 , and a module is completed.
[0083] If a beginning flag is set, it will progress to step s24 and peak hold processing will be performed. At step s24, the data of AT error A/D31 into which AT error signal is inputted first are read, and it compares with the value of AT error A/D31, and the peak value of a peak value register in step s25. If the A/the D value of read AT error A/D31 are larger than peak value, it progresses to step s26, and when [this] increasing the peak value data of a peak value register, actual A/D value will not be made into peak value, but only the differences 1/8 of A/D value, and the peak value to last time will make peak value data increase. That is, it is peak value = peak value + {(A / D value-peak value) /8} as peak value.
A ** value is set as a peak value register. Thereby, malfunction of the peak hold by the blemish of a disk or the noise can be prevented.
[0084] On the contrary, hold actuation is performed when A/D value is smaller than peak value. In this case, peak value = peak value + {(A / D value-peak value) /1024}
A ** value is set as a peak value register. That is, malfunction of the peak hold by the blemish of a disk or the noise can be prevented by it not only holding peak value data, but carrying out the difference of A/D value, and the peak value to last time 1/1024, and reducing peak value slowly also at this time.
[0085] If check the equalization beginning flag s6 and it is not set after actuation of peak value finishes, a module is ended at step s29. When it passes along this root, peak value data are during the timer period for 5ms which is waiting to converge to actual peak value.
[0086] If the equalization beginning flag s6 has left, while going to step s30 and integrating the value of a peak value register to an addition register, the count register of addition is carried out +one, and the count of addition is counted. And interrupt is ended at step s31.
[0087] Peak hold processing or addition processing is not performed by that by which a beginning flag will be reset if the timer for 16.6ms of the Maine flow chart of drawing 4 passes the deadline of (s9), either.
[0088] Thus, only by the data of the discrete sample point of 50kHz, although AT error signal at the time of truck crossing is close to 5 to 10kHz, and the sample frequency of 50kHz, exact peak value and a bottom value are deduced, and it becomes possible to measure the amplitude value and the offset value of AT error signal after all. Moreover, convergence time amount can also be strongly set up in a noise appropriately by having set actuation of peak value to 1/8 or 1/1024 of a data difference. Thus, by having made it strong in a noise, even if it is a SUM signal with very many noises as compared with AT error signal, the amplitude at the time of truck crossing can be measured correctly. That is, even if it uses for the amplitude of a SUM signal and offset which are a signal adding all the outputs of the servo sensor divided into plurality in the same algorithm, a good measurement result can be obtained.
[0089] (b) AF offset adjustment" by "VFO amplitude
First, the servo condition at the time of regulating automatically is explained. It carries out in the condition of having started to AF servo, AT servo, and the trace servo.
[0090] It is necessary to hold the amplitude of each bit synchronization signal in a sector of the truck of a disk, and the VFO signal of the ID section which is recording the sector address etc., in order to obtain this VFO timing, ID reversion system operates normally, and a refreshable condition is required in the address.
[0091] Below, an adjustment procedure is explained. The range of offset impressed to AF servo loop for adjustment is decided based on the peak value data of AF-S character measured at the time of AF drawing in like the case of above-mentioned (a) "regulate [AF offset] automatically by AT signal amplitude." For example, it considers as half [of a S character peak].
[0092] Offset is changed with the resolution which divided the one half of this peak into eight equally. It measures 17 point by double sign both directions and the zero point.
[0093] VFO signal amplitude is first measured as offset zero, and amplitude value and an offset value are associated and memorized. Next, the above-mentioned resolution of one every step, offset is changed in the minus direction, and the offset which gave with the VFO signal amplitude value in each step is associated and memorized. This is performed to within the limits of said

range, i.e., eight steps.
[0094] Moreover, it was parallel at this time and maximum distinction of VFO signal amplitude was performed, and when the VFO signal amplitude which is less than 80% of maximum during each step measurement is measured, the sequence which does not enlarge the absolute value of offset any more is taken. This is for preventing a focus condition's deteriorating extremely and a focus separating.
[0095] Next, again, offset is changed to zero and a plus direction is shortly measured like the minus direction.
[0096] If measurement of all the points is completed, the maximum of VFO signal amplitude value will be found. And AF offset which gives 80% of amplitude of maximum is computed. The offset value which is below these 80% is calculated by the linear interpolation from the offset value of order.
[0097] It considers as setting offset, an average, i.e., the center, of each 80% fall offset of a plus direction and the minus direction. Finally offset is gradually changed to the setting offset. Here, since a focus causes a gap, an abrupt change's is not good. Moreover, a focus should just set up the offset value which shifts and cuts the 80 above-mentioned% as detection threshold level.
[0098] Below, the VFO signal amplitude measurement approach is explained. This VFO signal amplitude measurement is processed by one eighth of 50kHz servo interrupt timing. By the RF signal from mechatronics 10, the VFO amplitude data detected by the R/W signal-processing system 9 are inputted into CPU1, are digitized by the A/D converter of CPU1, read VFO amplitude data, and integrate and equalize them every 1/8 50kHz sample. For example, the data during 10ms per each AF offset point are averaged.
[0099] Thus, in order to set up the value of AF offset, the coarse control, fine tuning, and blank detection level were explained. In this way, middle level of the offset value of "AF offset regulating automatically by AT signal amplitude" and the offset value in "AF offset adjustment by the VFO amplitude" is considered as last setting AF offset, for example. And while memorizing this offset value in memory, it is added to an adder 23 as an output level of the AF offset 22 of drawing 1 .
[0100] (2) AT&SUM offset (a coarse control, slice level, blank detection level)
Hereafter, the coarse control in AT&SUM offset, slice level, and blank detection level are explained to a detail, respectively. In a regulating function, especially, a part required for regulating [of AT offset &SUM offset] automatically is extracted, and the block configuration is shown in drawing 6 .
[0101] A disk is rotated with constant speed and it performs "AT&SUM offset regulating automatically" after AF offset regulating automatically by laser lighting as the light source, AF drawing in, and the above-mentioned (1) AF offset by AT signal amplitude.
[0102] (a) "AT&SUM offset regulating"
First, the servo condition at the time of regulating automatically is explained. Where AT actuator is held in the center by the REMPOJI servo in the condition of having started to AF servo, it performs AT&SUM offset regulating automatically. AT signal amplitude receives effect by the AGC function. If the normalization speed of response of AGC3 is made high, a strain will arise to AT signal under the effect of a sum signal. For this reason, it is necessary to carry out the peak hold of the normalization signal, i.e., sum signal, of AGC3. Therefore, in AT error A/D31, it is required to be in this peak hold condition.
[0103] Although AT actuator is mostly fixed in the center of the movable range by the REMPOJI servo, in order to compensate that an optical spot crosses a truck at this time, an objective lens is vibrated very small. The driving signal of the fixed period of a sine wave is given to LP drive offset 56 at a REMPOJI servo loop, and an objective lens is vibrated. For example, the period of about 100Hz and vibration of about about ten micrometers are generated.
[0104] This driving signal is added just before the D/A output of a REMPOJI servo like the configuration of drawing 6 . This is the problem of the quantization error by digitization of A/D, and it is because vibration with smoother adding a signal just before a D/A output can be carried out rather than it adds a sine wave as desired value of a REMPOJI servo loop. Moreover, it is necessary to set up the band of a REMPOJI servo narrowly for a smooth vibration.

[0105] Next, an adjustment procedure is explained. The peak and bottom of AT error signal at the time of truck crossing are measured from the data of AT error A/D31. The average of peak value and a bottom value is considered as AT offset, and this is added to the output of AT error A/D31 with an adder 33 within CPU1 (it subtracts on a FARM).
[0106] Moreover, in order to set up the threshold level of AT signal binary-ized comparator in AGC-IC, measured AT offset value is changed at a convention rate corresponding to hardware, and it sets to serial D/A4.
[0107] The peak value and the bottom value of a SUM signal at the time of truck crossing are similarly measured from the data of SUM-A/D. The average of peak value and a bottom value is considered as SUM offset, and this is used for a SUM signal by each module as binary-ized threshold level. Since binary-ization of a SUM signal does not use an external comparator, there is no need of setting it as D/A. Moreover, AF by the SUM signal shifts and makes an average with a bottom value and a zero level, i.e., the median, the threshold level of detection.
[0108] Below, an AT&SUM signal offset measuring method is explained. AT signal and a SUM signal are the same, and a fundamental measuring method describes them focusing on the case of AT signal below.
[0109] Fundamentally, it operates by the peak hold and bottom hold. Attack/hold property is set up so that the above equalization effectiveness and a noise may not be answered steeply. And the average of peak value and a bottom value is considered as offset. Moreover, let one half of the difference of peak value and a bottom value be the amplitude. This is processed to 50kHz servo interrupt timing.
[0110] Reading the output value of AT error A/D31, according to the size relation of difference with peak data or bottom data, an attack property subtracts one eighth of difference, and addition and a hold property are subtracting 1/1024 of difference.
[0111] It is parallel to the above processing, and a peak / bottom data is integrated and equalized for every 50kHz sample. For example, in the present version, the data between 16.6ms of one-revolution parts per point are averaged. In the case of a SUM signal, the output value of AT error A/D31 to read is transposed to SUM-A/D71.
[0112] Since an AT&SUM signal offset measuring method is the same as that of the algorithm of AT signal amplitude measurement explained by drawing 4 and drawing 5 , detailed explanation is omitted.
[0113] (3) In an eccentricity measurement regulating function, a part required for especially eccentricity measurement is extracted and shown in drawing 7 . First, a disk is rotated with constant speed, the laser as the light source is turned on, and the eccentricity of a disk is measured in the condition of not carrying out trace actuation of truck flattery, after AF drawing in and AT drawing in.
[0114] The eccentricity of a disk is in the condition which stopped carriage, and is measured with a REMPOJI signal when having applied AT servo. A rotation phase is got to know by the rotation synchronous counter of a disk, it synchronizes with this, and the eccentricity of a disk is measured and memorized. For example, a part for disk 8 rotation is equalized. Moreover, the amount of data for one rotation is about 104 pieces. This eccentricity data is used in order to cancel a part for eccentricity from a REMPOJI signal so that carriage may not follow eccentricity at the time of trace actuation.
[0115] In above-mentioned drawing 7 , the amount of trace offset of the trace offset 62 is added to the REMPOJI signal of LP error A/D51 with an adder 63 (addition actually turns into that it is subtracted), and eccentricity is set up in the form which synchronized with disk rotation.
[0116] Below, it explains eccentricity measurement regulating automatically. The servo condition at the time of regulating automatically is performed in AF and the condition of having drawn to AT. Moreover, although it is not indispensable under the situation that there is no extraneous vibration, if the vibration from the outside is taken into consideration, it is necessary to fix carriage to somewhere.
[0117] Furthermore, an adjustment procedure is explained. 110 data tables are cleared. To the 50kHz timing of 1/4, LP error A / D value of LP error A/D51 are integrated on the table of the phase which the rotation synchronous counter of a disk shows. Since a synchronous counter is

1/8 which is 50kHz, A / D value data of LP error A/D51 of two samples are gained with one phase each. If the time amount for eight rotations passes, it will equalize over the whole table.
[0118] Equalization processing is explained first. It asks for the average eccentricity data for every phase of disk rotation, and the average for a total phase (i.e., the eccentricity gone around) is computed. Since this average becomes a part for DC of an eccentricity data table, it subtracts a part for this DC from the eccentricity data of a Gentlemen phase, and let it be the eccentricity table the amount of DC is not.
[0119] In the above, three kinds of concrete algorithms were explained. Although it is the algorithm which processes all in quest of the averages, such as AF offset, AT offset, and eccentricity, etc., this invention may not be limited to this algorithm and other algorithms are sufficient as it.
[0120]
[Effect of the Invention] As explained above, the problem which cannot accelerate the sampling frequency in a digital servo, or the problem of a quantization error is solvable with this invention.
[0121] The precision of amplitude measurement improves by changing the band of the REMPOJI servo loop for immobilization of an objective lens, always being able to realize truck crossing, even if it is the disk which does not have eccentricity from vibrating an objective lens intentionally smoothly in a narrow REMPOJI servo band at the time of measurement of the servo signal at the time of truck crossing, and moving smoothly in the time of seeking, and the time of others.
[0122] Moreover, also in the limited sampling frequency in a digital servo, by the easy memory operation for every sample timing, the amplitude of an exact servo signal can be caught and the precision of amplitude measurement improves.
[0123] Moreover, the eccentricity of a disk can be correctly measured by carrying out the measurement storage of the REMPOJI signal in the form which synchronized with the sampling timing of a digital servo, and synchronized with rotation of a disk.
[0124] These can realize a highly precise servo and high density and a large capacity optical disk can be realized. Moreover, optic precision, disk precision, or the precision of the adjustment at the time of manufacture can be dropped on performing regulating [which suited the condition of a disk, and the device status at that time] automatically, and equipment can be manufactured by low cost.

[Translation done.]

TECHNICAL FIELD

[Industrial Application] About the optical information record regenerative apparatus which performs informational record playback to an information record medium using a laser beam, especially, this invention establishes a truck slot in the record medium of the shape of the shape of a disk, and a card, and relates to control of the laser-beam spot of the equipment which performs informational record playback along this truck.
[0002]
[A Prior art and a background] In an optical disk unit, with an objective lens, the semiconductor laser as the light source narrows down the light which carries out outgoing radiation to the diameter of about 1 micron, and irradiates it on an optical disk.
[0003] In order to make this optical spot narrowed down small focus on the information record-medium side of an optical disk, the feedback loop control usually called a focusing servo is used.
[0004] Moreover, in order to position an optical spot to the code track on a medium side, the feedback loop control called a tracking servo is used.
[0005] These control loops consist of objective lens actuators which convert the power of the output of the amplifier 3. amplifier which amplifies the output of the photosensor 2. photosensor which usually receives the reflected light of the following elements and 1. disk with the control stabilization compensator 4. control stabilization compensator pressed down on predetermined level, and drive it.
[0006] The direction position error of a focus of an optical spot and an optical disk side is detected, an objective lens is moved to the perpendicular direction of an optical disk side with an actuator, and an optical spot is controlled by the quantity of light which receives light with the above-mentioned photosensor on a disk side.
[0007] The direction position error of a truck of the truck on a disk and an optical spot is detected, an objective lens is moved along an optical disk side with an actuator, and an optical spot is controlled by the quantity of light which receives light with a photosensor similarly on a truck.

[Translation done.]

EFFECT OF THE INVENTION

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[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, offset occurs to the position error signal of the direction of a focus, and the direction of a truck according to offset, an installation error of an optic, etc. which an electrical circuit has in actual equipment, and it has been the failure of construction of servo system with a high precision. For this reason, how to adjust offset of a position error signal automatically at the time of starting of equipment etc. is considered. Many of these approaches add how many kinds of those offset intentionally in a servo loop, and it is searching for offset amendment from which the best signal is acquired. For example, sequential impression of about 20 steps of the offset is carried out at a focal servo loop, and the amplitude of a tracking signal is measured, the offset which gives the greatest tracking error signal amplitude is found out, and it adds to a servo loop by considering this as adjustment offset.
[0009] Moreover, aiming at the miniaturization of equipment, low-cost-izing, and high-performance-izing, digitization of the servo circuit of an optical disk is performed briskly in recent years. In a digital servo, A/D conversion of the position error signal acquired from the photosensor is carried out, the amount of position errors is evaluated, this numeric value is calculated by the digital circuit, the microprocessor, DSP (digital signal processor), etc., and the configuration which drives an actuator as a proper driving signal is taken. Although it surely becomes a discrete time control in a digital servo, sample spacing cannot be recklessly made minutely high in this case from the relation of A/D-conversion time amount and digital-signal-processing time amount.
[0010] For example, even in the tracking servo which needs the fastest processing in an optical disk unit, it becomes the sampling frequency of at most about 50kHz.
[0011] Then, when performing a digital servo, measurement of the signal amplitude for the automatic adjustment at the time of equipment starting becomes difficult for this low sampling frequency. That is, since the highest frequency of truck crossing by the eccentricity of a disk is set to 5kHz - about 10kHz when it is going to measure a tracking error signal, in the sampling frequency of 50kHz, only 10 sample point can be acquired from per [5] truck crossing wave round term. Now, the amplitude value of a truck crossing signal or offset cannot be measured correctly.
[0012] Moreover, as for truck crossing by disk eccentricity, an optical spot goes to the truck (correctly twice) for eccentricity and comes back by one disk revolution. The moment the crossing direction is reversed, a tracking error signal cannot reach to amplitude value, and the amplitude of a truck crossing signal and offset cannot be too measured correctly with a peak with a halfway value.
[0013] Therefore, although a policy which supervises the frequency of a truck crossing signal and forbids measurement on a low frequency and a high frequency was also considered, in order to raise the accuracy of measurement, a measurement authorization frequency could not be made large, but increase of adjustment time amount was caused. Moreover, for the reason, adjustment precision also needed to reach a compromise to some extent, and had dropped controllability ability.
[0014] Moreover, although it is necessary to make immobilization or a consciousness target move an objective lens at the time of above-mentioned truck crossing signal amplitude

measurement, for that, the location of an objective lens is measured and feedback control is performed to a tracking actuator. On the other hand, in order to reproduce or record information required as an optical disk unit, at the time of seeking which moves a light beam to a desired truck, it is necessary to fix so that this objective lens may not be shaken by vibration by seeking migration. However, in immobilization of the objective lens at the time of seeking, since vibration by seeking migration is large, it is necessary to make high the Ford back gain of this objective lens immobilization. Therefore, in the objective lens fixed feedback control at the time of truck crossing signal amplitude measurement, the driving force by the quantization error which surely remains by digital control is greatly impressed to an actuator, and an objective lens vibrates minutely. Therefore, highly precise truck crossing signal amplitude measurement was difficult.
[0015] Moreover, when carried out by the 50kHz same to measurement of the eccentricity of a disk as the sampling frequency of a tracking servo, when the eccentricity data for disk 1 rotation were memorized, 833 memory was needed as 3600rpm, the rotational frequency occupied the part with precious big memory which it has, such as CPU, and memory effectiveness was very bad.

[Translation done.]

OPERATION

[Means for Solving the Problem and its Function] It is what was made in order that this invention might solve the fault and trouble of the above-mentioned versatility. In the optical information record regenerative apparatus which irradiates a light beam and performs informational record playback to the record medium which has two or more identifiable code tracks optically The 1st actuator made to move the location of the spot of a light beam in the direction which crosses a code track, The 2nd actuator made to move the 1st actuator in the direction which carries this 1st actuator and crosses a code track, A seeking means to move to a movement magnitude detection means to detect the movement magnitude of the 1st actuator, and the code track aiming at a light beam, using the 2nd actuator, The 1st actuator is driven with the output of a movement magnitude detection means working [a seeking means]. Have a maintenance means at the time of seeking holding the 1st actuator, and the 1st actuator is driven with the output of a movement magnitude detection means in addition to [of a seeking means] working. It has an actuator maintenance means to hold the 1st actuator, and is characterized by making the control-loop band of an actuator maintenance means narrower than the control-loop band of a maintenance means at the time of seeking.

[0017] Furthermore, a truck error detection means by which the reflected light from a record medium detects the amount of location gaps of the spot location of a light beam, and a code track, The output of a truck error detection means Processing is performed for the output of a servo control means to perform an operation for the output of a sampling means and a sampling means which carries out a sample a predetermined sample period a predetermined sample period, and to drive an actuator a predetermined sample period, and a sampling means, a predetermined sample period. It has a measurement means to measure the output of a truck error detection means, in making a truck adjust the location of the spot of a light beam, it operates a servo control means, and in measuring the output of a truck error detection means, it operates a measurement means.

[0018] Furthermore, the trouble from the former is solved in operating a servo control means and operating a movement magnitude measurement means to coincidence, where the 2nd actuator is stopped with a movement magnitude measurement means to measure the movement magnitude of the 1st actuator, with the output of the 2nd sampling means which samples the output of a movement magnitude detection means, and the 2nd sampling means with the period beyond a predetermined sample synchronization.

[0019] Moreover, in the information record regenerative apparatus which irradiates a light beam and performs informational record playback to the record medium which has two or more identifiable code tracks optically, it has an error signal detection means to detect a tracking error signal, and a tracking servo means to irradiate a light beam and to follow an objective lens in a code track, and is characterized by making the band of the tracking control loop at the time of playback narrower than the band of the tracking control loop at the time of seeking. Then, at the time of playback, it follows correctly by the precise servo loop, and an early jump action can be attained at the time of seeking.

[Translation done.]

* NOTICES *

EXAMPLE

[Example] The outline of the whole in regulating automatically, such as offset of the optical information record regenerative apparatus by this invention, is explained.
[0021] (1) The block diagram of the hardware of optical-magnetic disc equipment servo system which carried out this invention to hardware configuration drawing 2 is shown. The light source for 10 being mechatronics, and an optical disk being inserted in drawing, and carrying out record playback according to the truck of an optical disk, The optical system of an objective lens, the sensor for signal processing, etc., and the electric system which processes the signal, The mechanical system of the actuator which operates mechanically, a spindle motor, etc. is built in. 9 is the R/W signal-processing system of reading from the RF signal which is an output signal from mechatronics 10, modulating write-in data or outputting a VFO amplitude signal. [restoring to a signal] 1 is CPU, the whole system containing hardware is controlled, the VFO amplitude signal from the R/W signal-processing system 9 is processed, and 4 is serial D/A. 3 is AGC which carries out control magnification of the amplitude of servo signals, such as an output of the focal error signal and tracking error signal of mechatronics 10, and serial D/A. 2 is the A/D& D/A converter which carries out D/A conversion of the electrical-potential-difference data according to CPU1 in carrying out A/D conversion of the output of AGC3 ****, and performs signal transformation between analog-to-digital one. 5 is the AF/AT driver which carries out power amplification of the drive signal of the automatic focus tracking from A/D& D/A converter 2, and drives an actuator. 6 is a LM driver who amplifies the drive signal for linear motors which moves the location of the pickup from A/D& D/A converter 2. The exterior ROM 7 and the exterior RAM 8 are memory which memorizes the program used by the memory in CPU1 when insufficient, and temporary data.
[0022] Servo processing of this example is a software servo by CPU1. It is performing also regulating [of servo system] automatically by the firmware processing in almost all the parts CPU 1. Since a setup of the threshold level of the comparator for a truck count which is not illustrated which needs rapidity, and offset adjustment of AGC3 cannot be processed within CPU1, the electrical potential difference has been set to the external device besides CPU1 with serial D/A converter 4. Hereafter, it explains, illustrating the detail of each part.
[0023] (2) Since high-speed processing is possible, the whole system is controlled by CPU1RISC (Reduced Instruction Set Computer) type CPU and the hardware multiplier is built in, 16*16=32 bit multiplication can perform in 150ns, and builds in the A/D converter of 8 bits and 8ch.
[0024] (3) All the channel conversion times of 28 bit A/D of A/D& D/A converters are 1.7microS by time sharing at the time of 8ch input and 8ch scan actuation. 8-bit D/A has 4ch output and the settling time for about 3 microseconds.
[0025] (4) It has serial D/A4 serial-communication form 12ch and a 8-bit D/A converter. The settling times are 300 microseconds and a low speed.
[0026] (5) Receive servo sensor output 8ch from AGC3 mechatronics 10, and while generating each servo signals, such as (Focus AF) error signal / (Tracking AT) error signal / the total quantity of light (SUM) signal, perform normalization (AGC) actuation of each servo signal. Moreover, a lens position sensor output is received from mechatronics 10, a lens position (REMPOJI) signal is generated, and APC is applied to REMPOJI LED which detects a lens

position.
[0027] (6) Carry out 2ch possession in portions of the AF/AT driver 5 bridge-type output-power operational amplifier, it consists of power amplifier for automatic focus auto tracking, and the maximum drive current to an actuator is 0.7A.
[0028] (7) With the driver of the linear motor which sets up a LM driver 6 lens position, it is the driver which drives a voice coil and has maximum output 2A.
[0029] (8) Although there are built-in ROM and RAM in the exterior ROM 7 and external RAM8CPU1, since storage capacity runs short, also outside, it has memory. It is used by possible processing also at the low speed which is mainly neither an object for the processing sections of a system-control system, nor the real-time operation of a servo. Needing a big memory area, even if it is a regulating system, the part which seldom requires rapidity uses Exterior RAM.
[0030] (9) Restore to it and output the regenerative signal from mechatronics 10 in the part for processing of R/W signal-processing 9 RF signal, modulate the signal data recorded on the optical disk of mechatronics 10 by the RF, and output to the electric system and optical system in mechatronics. The signal-processing section which generates the hold value of the VFO amplitude required for regulating [of AF offset] automatically is also constituted.
[0031] (10) It is the abbreviated-name mechatronics of mechanical electronics which can equip with mechatronics 10, for example, a 3.5 inch magneto-optic disk. It consists of a head of the usual magneto-optic disk, a spindle motor for disk rotation, etc. The objective lens which there is an optical head same separation optical type [the] as what is carried in the usual optical-magnetic disc equipment, and is carried in mechatronics 10 at the carriage which is a part for moving part is movable in the direction of a focus, and the direction of tracking. A focus servo and a tracking servo are performed by moving this objective lens. Moreover, carriage and the sensor for lens positions which detects the relative location of the direction of tracking of an objective lens are formed, since carriage is driven at the time of tracking, it is used, or it is used for location immobilization of the objective lens under seeking. Since an objective lens location sensor, a call, and a lens position are detected, this sensor is also called a "REMPOJI" sensor. The detection approach of this sensor fixes an optical light emitting-receiving element called a photo interrupter to the carriage section, and can realize it by putting the gobo which engaged with the objective lens on the optical path of a photo interrupter. A linear motor is carried in this carriage section, and it operates as the 2nd actuator.
[0032] The signal from the optical head which is in mechatronics 10 part by the configuration of each part of the above turns into a servo signal which AGC3 normalized, and digitizes this servo signal with the A/D converter of A/D& D/A converter 2.
[0033] If a focal servo loop is explained, A/D conversion of the focal error signal (drawing AF) outputted from AGC3 will be carried out, and it will consider as digital value. And based on this digital value, the filter operation of servo loop stabilization is performed by CPU1, the result of an operation is outputted to the D/A converter of A/D& D/A converter 2, and the focusing actuator in mechatronics 10 is driven to an analog signal with AF driver amplifier of conversion (drawing AF DRV) and the AF/AT driver 5.
[0034] Similarly, a tracking loop formation also processes the tracking error signal (drawing AT) outputted from AGC3, and is constituted, and it is AT. The signal outputted as DRV drives the tracking actuator in mechatronics 10 with AT driver amplifier of the AF/AT driver 5. [as well as a focal servo loop] These details are clarified by the below-mentioned explanation.
[0035] The block diagram of the servo-system function in the example of this invention is shown in drawing 1 .
[0036] Many regulating [of servo system] automatically are adjusted on the digital numeric-value level of the CPU1 interior. Serial D/A4 which is the exterior a part is used.
[0037] (A) It is inputted into the A/D-converter part of A/D& D/A converter 2 from the focus servo system AGC 3, and the data changed into digital value are shown as AF error A / a D value of the AF error A/D block 21. AF error A / D value output of the AF error A/D block 21 are added with the data and the adder 23 of the AF offset 22, and serves as AF error data by which offset adjustment was carried out. The data shown with the monitor point 24 which is the

output of this adder 23 serve as a base of AF error signal, and the error signal for a focus servo or a focus shifts, and is used for monitors, such as detection.
[0038] In regulating actuation, it shakes in order to set the value of the data of this AF offset 22 as actually various values and to try it, and the monitor of the amplitude of AT error signal or the amplitude of a RF signal is carried out, and the focal best point is found.
[0039] At least the data shown with the monitor point 24 are calculated with the phase compensating filter 25, the multiplication of this data is carried out with the adjustable control signal and multiplier 27 of the variable gain adjustable block 26 for loop-gain adjustment, and it is outputted to AF drive D/A converter section 28 of A/D& D/A converter 2.
[0040] (B) It is the configuration same on a tracking servo system basic target as a focus servo system. It is inputted into the A/D-converter part of A/D& D/A converter 2 from AGC3, and the data changed into digital value are shown as an output of the AT error A/D block 31. The output of the AT error A/D block 31 is added with the AT offset data 32 and an adder 33, and serves as AT error data by which offset adjustment was carried out. The AT offset 32 performs amendment of the offset by the lens location besides DC-offset.
[0041] In regulating actuation, offset is measured with the signal amplitude at the time of truck crossing which appears in the monitor point 34 when making AT offset into zero. According to that measured value, AT offset value of the AT offset 32 is determined, at least the data shown with the monitor point 34 are calculated with the phase compensating filter 35, the multiplication of this data is carried out with the adjustable control signal and multiplier 37 of the variable gain adjustable block 36 for loop-gain adjustment, and it is outputted to AT drive D/A converter section 38 of A/D& D/A converter 2. The threshold level value of AT binary-ized threshold level D/A39 is set up in that case.
[0042] AT actuator needs to receive the drive of the jump control 40 and REMPOJI servo drive other than a tracking servo, and has expressed it with a switch 41 by a diagram. Output of the switch 41 A power drive is carried out by AT drive D/A38, and AT actuator is driven.
[0043] (C) Like a REMPOJI servo-system focus servo system, LP output which shows the lens position of AGC3 is digitized in the A/D-converter part of A/D& D/A converter 2, and is used as the data of REMPOJI error A/D51, and LP offset value of the LP offset 52 is added to it with an adder 53 by the first rank, and it serves as data of the REMPOJI monitor point 54. Next, the phase compensating filter 55 performs an amendment operation, and LP drive offset value from LP drive offset 56 is further added with an adder 57, and it is referred to as adjusted REMPOJI data at various functional modules. Here, since gain precision is not required, unlike a focus servo system, a gain adjustment is not performed.
[0044] In order to make a truck cross compulsorily in the case of measurement of the amplitude of AT error signal, the drive offset 56 of low frequency is added to the output stage of a REMPOJI servo with an adder 57 as drive offset data, and the objective lens is vibrated.
[0045] (D) The trace offset value by the trace offset 62 is added to the data of trace servo-system REMPOJI error A/D51 with an adder 63, they are adjusted, and it considers as the monitor point 64, and an amendment operation is carried out with the phase compensating filter 65, and at least a degree is outputted as an analog value by LM drive D/A68 for linear motors, and is used for various functional modules.
[0046] The trace offset 62 has the function which cancels a part for the eccentricity at the time of disk rotation. The spindle rotation synchronous counter counted 1 rotation 100 count extent every synchronizing with rotation of the spindle motor of a disk rotation motor is constituted in CPU1, the trace offset data which is equivalent to a part for eccentricity synchronizing with a spindle rotation synchronous counter at the time of trace is updated, and it becomes the REMPOJI signal with which the eccentric component was removed at the monitor point 64.
[0047] The switch 67 has realized the switch with the output of the phase compensating filter 65, and the seeking control block 66 like AT servo. And the output of a switch 67 drives the linear motor which is inputted into LM drive D/A68 and moves the location of optical system.
[0048] (E) Call a SUM signal the signal adding all the outputs of the servo sensor divided into SUM signal system plurality. A SUM signal is digital-data-ized in the A/D section of A/D& D/A converter 2, the threshold level data of binary-izing of a SUM signal are determined, or AF by

the SUM signal shifts and determines detection threshold level data.
[0049] [Explanation of each algorithm] Eccentricity measurement is hereafter explained further to a detail, respectively about a coarse control [in / level / the coarse control in AF offset, fine tuning, and / blank detection / AT&SUM offset], slice level, and blank detection level.
[0050] (1) AF offset (a coarse control, fine tuning, blank detection level)
In a regulating functional block diagram (drawing 1), a part required for especially AF offset regulating automatically is extracted and shown in drawing 3 .
[0051] Focal offset regulating automatically is roughly divided into two regulating automatically. One is the offset adjustment which made the amplitude of a tracking error signal the index, and another is the offset adjustment which made the amplitude of an ID section VFO signal the index. The former is called "AF offset regulating automatically by AT signal amplitude", and the latter is called "AF offset adjustment by the VFO amplitude."
[0052] A disk is rotated with constant speed and it performs "AF offset regulating automatically by AT signal amplitude" after laser lighting and AF drawing in. Then, "AF offset adjustment by the VFO amplitude" is performed in the state of AT drawing in and trace. These two regulating automatically are independent modules, and if it performs all regulating automatically, finally AF offset by "AF offset adjustment by the VFO amplitude" will be set up.
[0053] By combining these two AF regulating automatically, it can build AF offset regulating [which can respond] automatically to some differences of AT-Max and VFO-Max. For example, "AF offset regulating automatically by AT signal amplitude" restricts the amount of actually shaken AF offset. Or middle level of the offset value of "AF offset regulating automatically by AT signal amplitude" and the offset value in "AF offset adjustment by the VFO amplitude" is considered as last setting AF offset.
[0054] Next, detailed explanation of this "AF offset regulating automatically by AT signal amplitude" automatically and "AF offset adjustment by the VFO amplitude" is given.
[0055] (a) AF offset regulating" by "AT signal amplitude
First, the servo condition at the time of regulating automatically is explained. It is in the condition which started to AF servo, and AT actuator for tracking servo adjustment performs offset regulating [of a focus servo] automatically in the condition of having been held in the center by the REMPOJI servo.
[0056] In a disk signal side, according to the 3 beam method, the spot for tracking is arranged in the location [every / one side / of one truck] deviated, the photosensor for tracking detection receives the primary [**] light of both sides, and the difference of a sensor output signal serves as AT signal, for example. Moreover, the photosensor of quadrisection of the reflected wave by the beam of 2 division receives the push pull method, and it makes a tracking error signal AT signal. ****** of AT servo controls the location of an objective lens so that the difference of a sensor output signal becomes zero.
[0057] The amplitude of AT signal receives effect by the function of AGC3. If the normalization speed of response of AGC3 is made high, a strain will arise to AT signal under the effect of a sum signal. For this reason, it is necessary to carry out the peak hold of the normalization signal, i.e., sum signal, of AGC3. Detection of AT signal amplitude needs to be in this peak hold condition.
[0058] Although AT actuator is mostly fixed in the center of the movable range by the REMPOJI servo, in order to guarantee that an optical spot crosses a truck at this time, an objective lens is vibrated very small. The driving signal of the fixed period of a sine wave is given to a REMPOJI servo loop, and an objective lens is vibrated. For example, the period of about 100Hz and vibration of about about ten micrometers are generated. As LP drive offset 56, the signal of the LP offset 52 is added to this driving signal by the output of LP error A/D51 of drawing 3 with an adder 53, and phase compensation is carried out with the phase compensating filter 55, and it is added just before the output to AT drive D/A38 of a REMPOJI servo like the configuration that the output signal of LP drive offset 56 can be applied with an adder 57. This is the problem of the quantization error by the digital signal of a REMPOJI servo, and is because vibration with smoother adding a signal just before the output to AT drive D/A38 can be carried out by adding a sine wave as desired value of a REMPOJI servo loop.

[0059] Moreover, it is necessary to set up the band of a REMPOJI servo narrowly for a smooth vibration. On the other hand, since the REMPOJI servo under seeking needs to suppress vibration of the objective lens under seeking as much as possible, it is large in a band, that is, needs to make gain high. Therefore, the large band of the REMPOJI servo under seeking by jump control of a code track is taken, and the configuration which narrows the band of a REMPOJI servo in the time of others is taken. This becomes possible because at least that in CPU1 changes the gain and the filter shape of the phase compensating filter 55 by the time of seeking, and the case of being other. In the software servo by the program memorized by ROM which used CPU1, doing in this way does not have any evil, and it is easily realizable.
[0060] By taking the large band of the REMPOJI servo under seeking, and narrowing the band of a REMPOJI servo in the time of others, during seeking, vibration of an objective lens can be suppressed as much as possible, the error resulting from vibration of the location of the objective lens detected by the truck count and the objective lens of passing speed is abolished, and stable seeking is enabled.
[0061] Moreover, by narrowing a REMPOJI servo band at the time of AF offset regulating automatically, the strain of the signal wave form by unnecessary vibration is lost, and the amplitude measurement precision of AT signal can be raised with moving smoothly [can move an objective lens smoothly, and a disk without eccentricity can also make truck crossing, and].
[0062] Furthermore, by narrowing REMPOJI servo bands other than the time of seeking, it can consider as the configuration which does not give driving force to an actuator superfluously, power consumption can be reduced, and generation of heat of an actuator can be suppressed.
[0063] Below, the adjustment procedure of AF offset regulating automatically by AT signal amplitude is explained. The amplitude range of offset impressed to AF servo loop for adjustment is decided based on the peak value data of the AF-S character as an output wave of AF error signal measured at the time of AF drawing in. For example, it considers as half [of a S character peak]. Offset is changed with the resolution which divided the one half of this S character peak into eight equally. It measures 17 point by plus minus both directions and the zero point.
[0064] First, as offset zero, the amplitude of AT signal is measured, and the amplitude value and offset value are associated and memorized. Next, it changes one step of offset at a time in the minus direction with the above-mentioned resolution, and AT signal amplitude value in each step and the given offset are associated and memorized. This is performed to within the limits of said range, i.e., eight steps.
[0065] Moreover, it is parallel at this time and maximum distinction of AT signal amplitude is performed, and when AT signal amplitude which is less than 80% of maximum during each step measurement is measured, the sequence which does not enlarge the absolute value of offset any more is taken. This is for preventing a focus condition's deteriorating extremely and a focus separating.
[0066] Next, again, offset is changed to zero and a plus direction is shortly measured like the minus direction.
[0067] If measurement of all the points is completed, the maximum of AT signal amplitude value will be found. And AF offset which gives 80% of amplitude of maximum is computed. The offset value which is below these 80% is calculated by the linear interpolation from the offset value of order.
[0068] it considers as setting offset, an average, i.e., the center, of each plus direction and minus direction [80% of] fall offset.
[0069] Finally, offset is gradually changed to the setting offset. Since a focus causes a gap, an abrupt change's is not good. Moreover, a focus should just set up the offset value which shifts and cuts the 80 above-mentioned% as threshold level of detection.
[0070] Next, the AT signal amplitude measurement approach is explained. Fundamentally, it carries out in a peak hold and bottom hold actuation. Attack/hold property is set up so that the average value of peak value or a bottom value can be measured correctly, and so that a noise may not be answered steeply. Under the present circumstances, let one half of the difference of a peak and a bottom be the amplitude. And it processes to 50kHz servo interrupt timing. Reading the output value of AT error A/D31, according to the size relation of difference with peak data

or bottom data, an attack property subtracts one eighth of difference, and addition and a hold property are subtracting 1/1024 of difference.

[0071] It is parallel to the above processing, and a peak / bottom data is integrated and equalized for every 50kHz sample. For example, the data between 16.6ms of one-revolution parts per one point of impression focus offset at the time of measurement are averaged.

[0072] Below, a flow chart is used and explained. As well as drawing 5 , the flow chart of an interrupt module is shown for the flow chart which becomes main [AT signal amplitude measurement by this invention] in drawing 4 .

[0073] For example, suppose that AT signal amplitude at the time of truck crossing was **100. Although the detection approach of the peak value which is +100 side is explained here, since the detection approach of the negative peak by the side of -100 (bottom) is also easily realizable only by taking a sign or size relation into consideration, explanation is omitted.

[0074] Peak hold processing is started at step 1 (s1). The register for equalization or the register of wave-like peak value is initialized first (s1). The register of peak value is a register used as the output of peak hold processing of AT error signal, and an addition register is an addition register for equalizing a peak hold value by fixed period. The count register of addition shows the count which integrated the peak hold value to the addition register. Therefore, average peak value is computable by "value of addition register"/"the value of the count register of addition."

[0075] In step s3, if a beginning flag is set, the peak hold processing in the interrupt processing explained by drawing 5 later will begin.

[0076] At step s4, in order to carry out time amount waiting until a peak value register converges on actual peak value from initial value, the timer for 5ms is started.

[0077] It judges that 5ms passed at step s5, and then an equalization beginning flag is set at step s6. After this, within the interrupt processing shown in drawing 5 , peak hold processing is performed succeedingly and addition processing of peak value is started further.

[0078] The timer which sets up the time amount equalized in step s7 is started, and it is made the time-average-ized thing for 16.6ms for disk 1 rotation here. Dispersion in the hoop direction of a disk can also be equalized by equalizing during disk 1 rotation.

[0079] If the progress for 16.6ms is judged at step s8, a beginning flag will be reset at step s9, and the peak hold within interrupt processing and addition processing will be suspended.

[0080] Then, the average is calculated at step s10. By breaking the value of an addition register by the value of the count register of addition, the peak value of an average of the average AT signal amplitude between disk 1 rotations is computable.

[0081] Next, an interrupt processing module is explained using drawing 5 .

[0082] This interrupt processing is started by 50kHz which is the basic sample frequency of servo system. If this module starts within interrupt processing, it will be confirmed first whether the beginning flag has left in step s22. It goes to the return of step s23 until a beginning flag s3 is set with the Maine flow chart of drawing 4 , and a module is completed.

[0083] If a beginning flag is set, it will progress to step s24 and peak hold processing will be performed. At step s24, the data of AT error A/D31 into which AT error signal is inputted first are read, and it compares with the value of AT error A/D31, and the peak value of a peak value register in step s25. If the A/the D value of read AT error A/D31 are larger than peak value, it progresses to step s26, and when [this] increasing the peak value data of a peak value register, actual A/D value will not be made into peak value, but only the differences 1/8 of A/D value, and the peak value to last time will make peak value data increase. That is, it is peak value = peak value + {(A / D value-peak value) /8} as peak value.

A ** value is set as a peak value register. Thereby, malfunction of the peak hold by the blemish of a disk or the noise can be prevented.

[0084] On the contrary, hold actuation is performed when A/D value is smaller than peak value. In this case, peak value = peak value + {(A / D value-peak value) /1024}

A ** value is set as a peak value register. That is, malfunction of the peak hold by the blemish of a disk or the noise can be prevented by it not only holding peak value data, but carrying out the difference of A/D value, and the peak value to last time 1/1024, and reducing peak value slowly also at this time.

[0085] If check the equalization beginning flag s6 and it is not set after actuation of peak value finishes, a module is ended at step s29. When it passes along this root, peak value data are during the timer period for 5ms which is waiting to converge to actual peak value.
[0086] If the equalization beginning flag s6 has left, while going to step s30 and integrating the value of a peak value register to an addition register, the count register of addition is carried out +one, and the count of addition is counted. And interrupt is ended at step s31.
[0087] Peak hold processing or addition processing is not performed by that by which a beginning flag will be reset if the timer for 16.6ms of the Maine flow chart of drawing 4 passes the deadline of (s9), either.
[0088] Thus, only by the data of the discrete sample point of 50kHz, although AT error signal at the time of truck crossing is close to 5 to 10kHz, and the sample frequency of 50kHz, exact peak value and a bottom value are deduced, and it becomes possible to measure the amplitude value and the offset value of AT error signal after all. Moreover, convergence time amount can also be strongly set up in a noise appropriately by having set actuation of peak value to 1/8 or 1/1024 of a data difference. Thus, by having made it strong in a noise, even if it is a SUM signal with very many noises as compared with AT error signal, the amplitude at the time of truck crossing can be measured correctly. That is, even if it uses for the amplitude of a SUM signal and offset which are a signal adding all the outputs of the servo sensor divided into plurality in the same algorithm, a good measurement result can be obtained.
[0089] (b) AF offset adjustment″ by ″VFO amplitude
First, the servo condition at the time of regulating automatically is explained. It carries out in the condition of having started to AF servo, AT servo, and the trace servo.
[0090] It is necessary to hold the amplitude of each bit synchronization signal in a sector of the truck of a disk, and the VFO signal of the ID section which is recording the sector address etc., in order to obtain this VFO timing, ID reversion system operates normally, and a refreshable condition is required in the address.
[0091] Below, an adjustment procedure is explained. The range of offset impressed to AF servo loop for adjustment is decided based on the peak value data of AF-S character measured at the time of AF drawing in like the case of above-mentioned (a) ″regulate [AF offset] automatically by AT signal amplitude.″ For example, it considers as half [of a S character peak].
[0092] Offset is changed with the resolution which divided the one half of this peak into eight equally. It measures 17 point by double sign both directions and the zero point.
[0093] VFO signal amplitude is first measured as offset zero, and amplitude value and an offset value are associated and memorized. Next, the above-mentioned resolution of one every step, offset is changed in the minus direction, and the offset which gave with the VFO signal amplitude value in each step is associated and memorized. This is performed to within the limits of said range, i.e., eight steps.
[0094] Moreover, it was parallel at this time and maximum distinction of VFO signal amplitude was performed, and when the VFO signal amplitude which is less than 80% of maximum during each step measurement is measured, the sequence which does not enlarge the absolute value of offset any more is taken. This is for preventing a focus condition's deteriorating extremely and a focus separating.
[0095] Next, again, offset is changed to zero and a plus direction is shortly measured like the minus direction.
[0096] If measurement of all the points is completed, the maximum of VFO signal amplitude value will be found. And AF offset which gives 80% of amplitude of maximum is computed. The offset value which is below these 80% is calculated by the linear interpolation from the offset value of order.
[0097] It considers as setting offset, an average, i.e., the center, of each 80% fall offset of a plus direction and the minus direction. Finally offset is gradually changed to the setting offset. Here, since a focus causes a gap, an abrupt change's is not good. Moreover, a focus should just set up the offset value which shifts and cuts the 80 above-mentioned% as detection threshold level.
[0098] Below, the VFO signal amplitude measurement approach is explained. This VFO signal amplitude measurement is processed by one eighth of 50kHz servo interrupt timing. By the RF

signal from mechatronics 10, the VFO amplitude data detected by the R/W signal-processing system 9 are inputted into CPU1, are digitized by the A/D converter of CPU1, read VFO amplitude data, and integrate and equalize them every 1/8 50kHz sample. For example, the data during 10ms per each AF offset point are averaged.
[0099] Thus, in order to set up the value of AF offset, the coarse control, fine tuning, and blank detection level were explained. In this way, middle level of the offset value of "AF offset regulating automatically by AT signal amplitude" and the offset value in "AF offset adjustment by the VFO amplitude" is considered as last setting AF offset, for example. And while memorizing this offset value in memory, it is added to an adder 23 as an output level of the AF offset 22 of drawing 1 .
[0100] (2) AT&SUM offset (a coarse control, slice level, blank detection level)
Hereafter, the coarse control in AT&SUM offset, slice level, and blank detection level are explained to a detail, respectively. In a regulating function, especially, a part required for regulating [of AT offset &SUM offset] automatically is extracted, and the block configuration is shown in drawing 6 .
[0101] A disk is rotated with constant speed and it performs "AT&SUM offset regulating automatically" after AF offset regulating automatically by laser lighting as the light source, AF drawing in, and the above-mentioned (1) AF offset by AT signal amplitude.
[0102] (a) "AT&SUM offset regulating"
First, the servo condition at the time of regulating automatically is explained. Where AT actuator is held in the center by the REMPOJI servo in the condition of having started to AF servo, it performs AT&SUM offset regulating automatically. AT signal amplitude receives effect by the AGC function. If the normalization speed of response of AGC3 is made high, a strain will arise to AT signal under the effect of a sum signal. For this reason, it is necessary to carry out the peak hold of the normalization signal, i.e., sum signal, of AGC3. Therefore, in AT error A/D31, it is required to be in this peak hold condition.
[0103] Although AT actuator is mostly fixed in the center of the movable range by the REMPOJI servo, in order to compensate that an optical spot crosses a truck at this time, an objective lens is vibrated very small. The driving signal of the fixed period of a sine wave is given to LP drive offset 56 at a REMPOJI servo loop, and an objective lens is vibrated. For example, the period of about 100Hz and vibration of about about ten micrometers are generated.
[0104] This driving signal is added just before the D/A output of a REMPOJI servo like the configuration of drawing 6 . This is the problem of the quantization error by digitization of A/D, and it is because vibration with smoother adding a signal just before a D/A output can be carried out rather than it adds a sine wave as desired value of a REMPOJI servo loop. Moreover, it is necessary to set up the band of a REMPOJI servo narrowly for a smooth vibration.
[0105] Next, an adjustment procedure is explained. The peak and bottom of AT error signal at the time of truck crossing are measured from the data of AT error A/D31. The average of peak value and a bottom value is considered as AT offset, and this is added to the output of AT error A/D31 with an adder 33 within CPU1 (it subtracts on a FARM).
[0106] Moreover, in order to set up the threshold level of AT signal binary-ized comparator in AGC-IC, measured AT offset value is changed at a convention rate corresponding to hardware, and it sets to serial D/A4.
[0107] The peak value and the bottom value of a SUM signal at the time of truck crossing are similarly measured from the data of SUM-A/D. The average of peak value and a bottom value is considered as SUM offset, and this is used for a SUM signal by each module as binary-ized threshold level. Since binary-ization of a SUM signal does not use an external comparator, there is no need of setting it as D/A. Moreover, AF by the SUM signal shifts and makes an average with a bottom value and a zero level, i.e., the median, the threshold level of detection.
[0108] Below, an AT&SUM signal offset measuring method is explained. AT signal and a SUM signal are the same, and a fundamental measuring method describes them focusing on the case of AT signal below.
[0109] Fundamentally, it operates by the peak hold and bottom hold. Attack/hold property is set up so that the above equalization effectiveness and a noise may not be answered steeply. And

the average of peak value and a bottom value is considered as offset. Moreover, let one half of the difference of peak value and a bottom value be the amplitude. This is processed to 50kHz servo interrupt timing.
[0110] Reading the output value of AT error A/D31, according to the size relation of difference with peak data or bottom data, an attack property subtracts one eighth of difference, and addition and a hold property are subtracting 1/1024 of difference.
[0111] It is parallel to the above processing, and a peak / bottom data is integrated and equalized for every 50kHz sample. For example, in the present version, the data between 16.6ms of one-revolution parts per point are averaged. In the case of a SUM signal, the output value of AT error A/D31 to read is transposed to SUM-A/D71.
[0112] Since an AT&SUM signal offset measuring method is the same as that of the algorithm of AT signal amplitude measurement explained by drawing 4 and drawing 5 , detailed explanation is omitted.
[0113] (3) In an eccentricity measurement regulating function, a part required for especially eccentricity measurement is extracted and shown in drawing 7 . First, a disk is rotated with constant speed, the laser as the light source is turned on, and the eccentricity of a disk is measured in the condition of not carrying out trace actuation of truck flattery, after AF drawing in and AT drawing in.
[0114] The eccentricity of a disk is in the condition which stopped carriage, and is measured with a REMPOJI signal when having applied AT servo. A rotation phase is got to know by the rotation synchronous counter of a disk, it synchronizes with this, and the eccentricity of a disk is measured and memorized. For example, a part for disk 8 rotation is equalized. Moreover, the amount of data for one rotation is about 104 pieces. This eccentricity data is used in order to cancel a part for eccentricity from a REMPOJI signal so that carriage may not follow eccentricity at the time of trace actuation.
[0115] In above-mentioned drawing 7 , the amount of trace offset of the trace offset 62 is added to the REMPOJI signal of LP error A/D51 with an adder 63 (addition actually turns into that it is subtracted), and eccentricity is set up in the form which synchronized with disk rotation.
[0116] Below, it explains eccentricity measurement regulating automatically. The servo condition at the time of regulating automatically is performed in AF and the condition of having drawn to AT. Moreover, although it is not indispensable under the situation that there is no extraneous vibration, if the vibration from the outside is taken into consideration, it is necessary to fix carriage to somewhere.
[0117] Furthermore, an adjustment procedure is explained. 110 data tables are cleared. To the 50kHz timing of 1/4, LP error A / D value of LP error A/D51 are integrated on the table of the phase which the rotation synchronous counter of a disk shows. Since a synchronous counter is 1/8 which is 50kHz, A / D value data of LP error A/D51 of two samples are gained with one phase each. If the time amount for eight rotations passes, it will equalize over the whole table.
[0118] Equalization processing is explained first. It asks for the average eccentricity data for every phase of disk rotation, and the average for a total phase (i.e., the eccentricity gone around) is computed. Since this average becomes a part for DC of an eccentricity data table, it subtracts a part for this DC from the eccentricity data of a Gentlemen phase, and let it be the eccentricity table the amount of DC is not.
[0119] In the above, three kinds of concrete algorithms were explained. Although it is the algorithm which processes all in quest of the averages, such as AF offset, AT offset, and eccentricity, etc., this invention may not be limited to this algorithm and other algorithms are sufficient as it.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the servo-system regulating block diagram of the optical-magnetic disc equipment which carried out this invention.
[Drawing 2] It is the hardware block diagram of the optical-magnetic disc equipment which carried out this invention.
[Drawing 3] It is the AF offset regulating block diagram of the optical-magnetic disc equipment which carried out this invention.
[Drawing 4] It is the flow chart of tracking signal amplitude measurement.
[Drawing 5] It is the flow chart of the tracking signal amplitude measurement which showed a part of flow chart of drawing 4 to the detail.
[Drawing 6] It is the AT&SUM offset regulating block diagram of the optical-magnetic disc equipment which carried out this invention.
[Drawing 7] It is the eccentric measurement block diagram of the optical-magnetic disc equipment which carried out this invention.
[Description of Notations]
1 CPU
2 A/D& D/A Converter
3 AGC
5 AF/AT Driver
10 Mechatronics
21 AF Error A/D
22 AF Offset
25 Phase Compensating Filter
28 AF Drive D/A
31 AT Error A/D
32 AT Offset
35 Phase Compensating Filter
38 AT Drive D/A
51 LP Error A/D
56 LP Drive Offset

[Translation done.]